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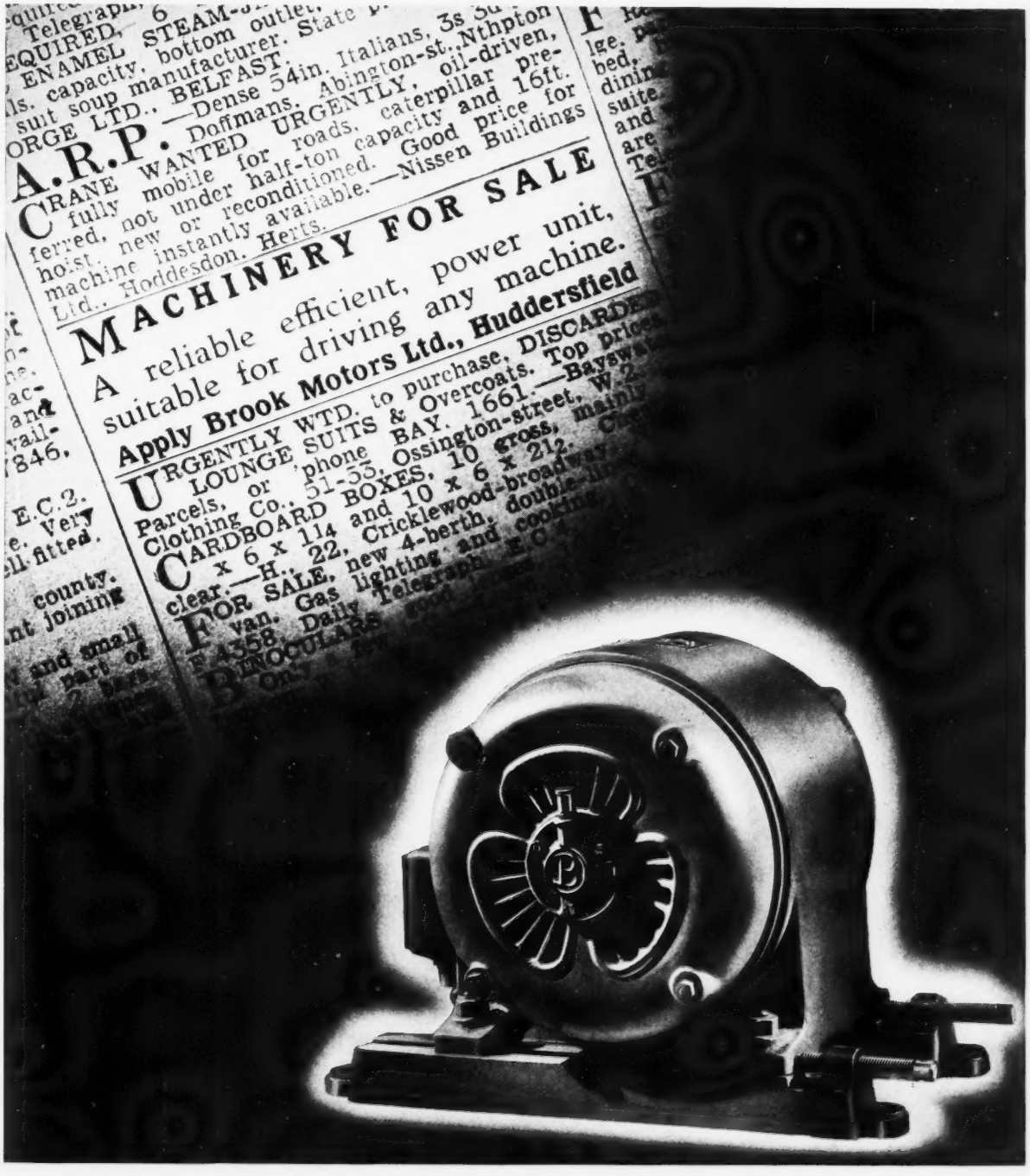
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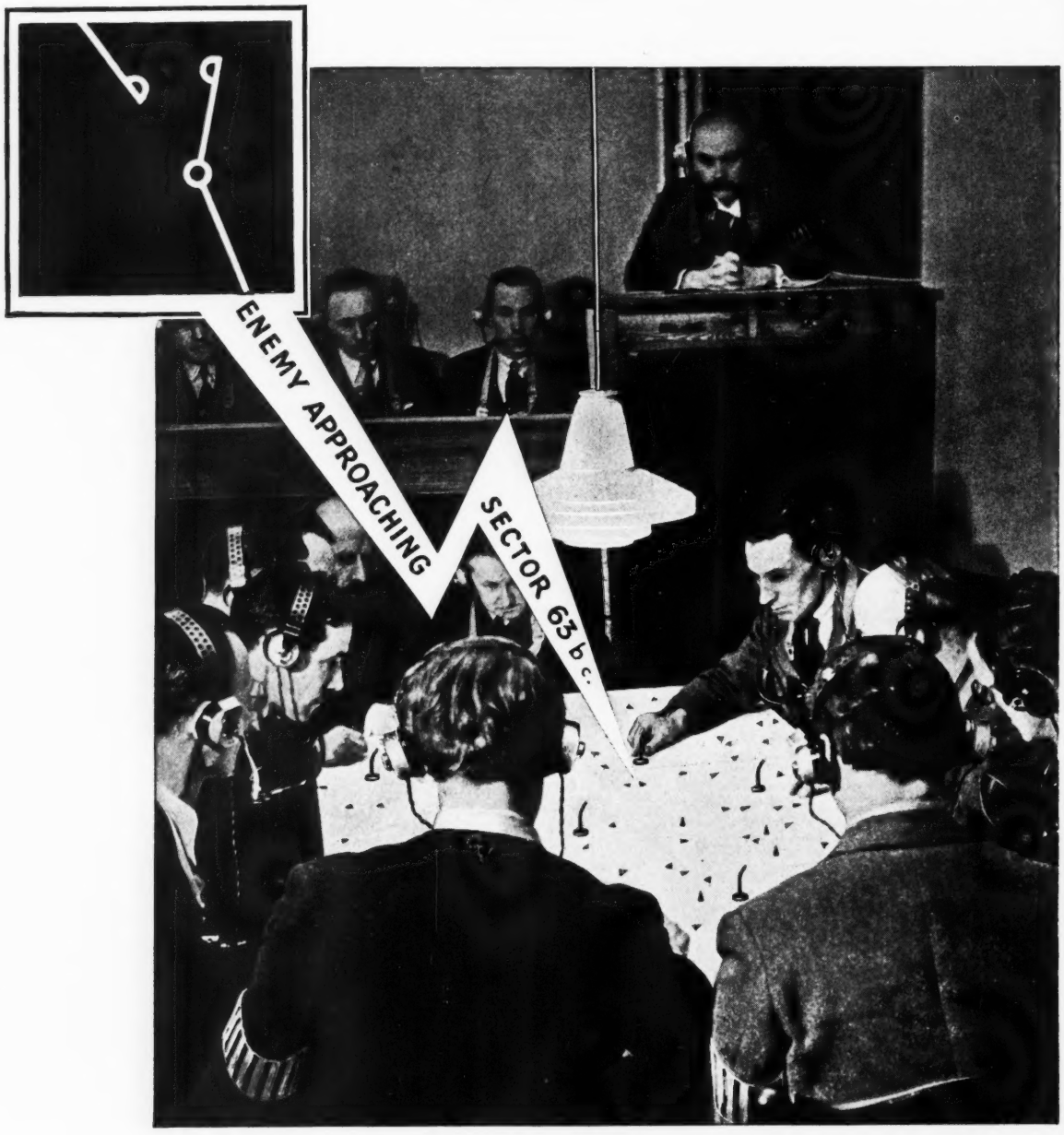

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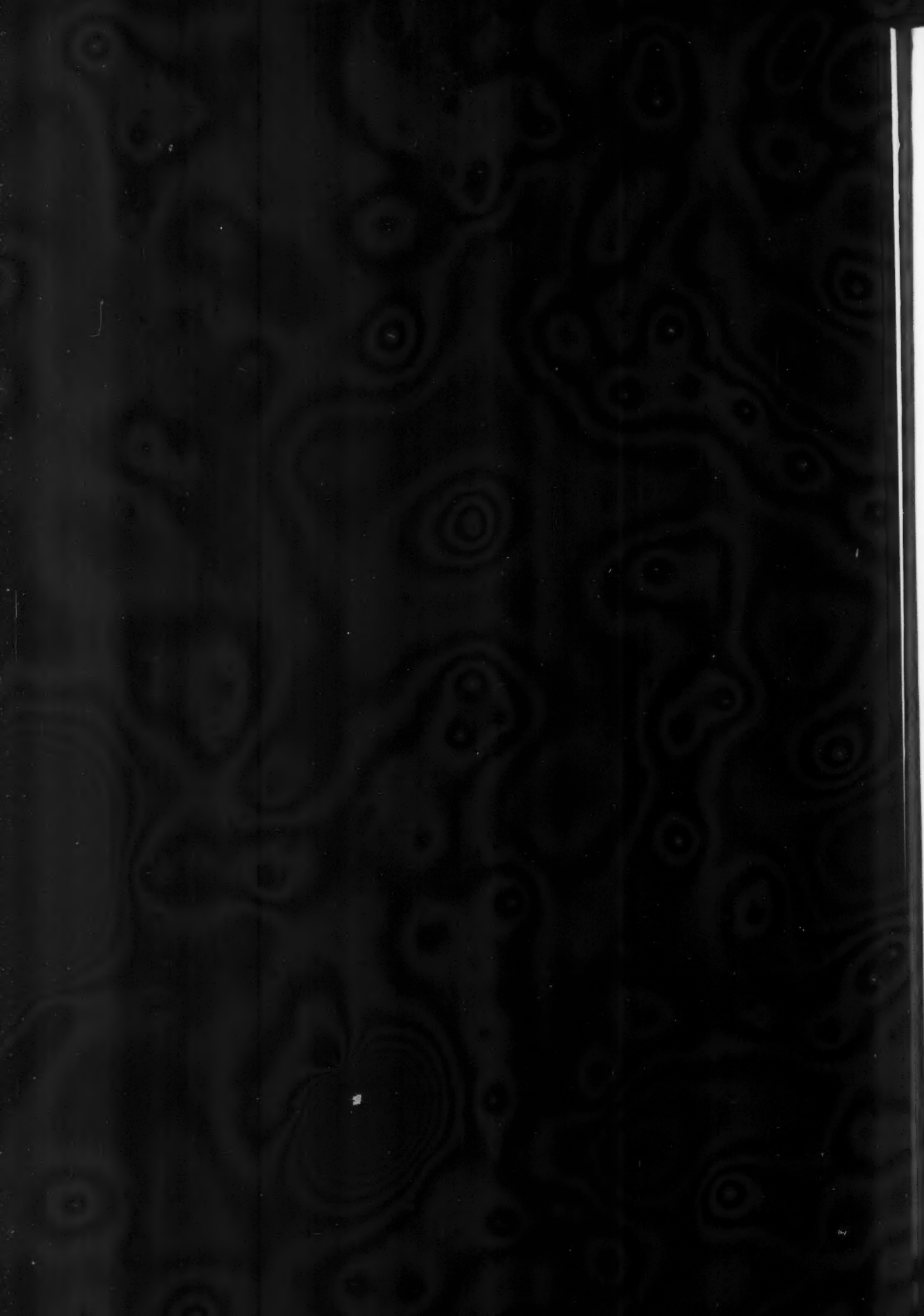

THE ELECTRICAL REVIEW

Volume CXXVIII — No. 3304

Friday, March 21st, 1941

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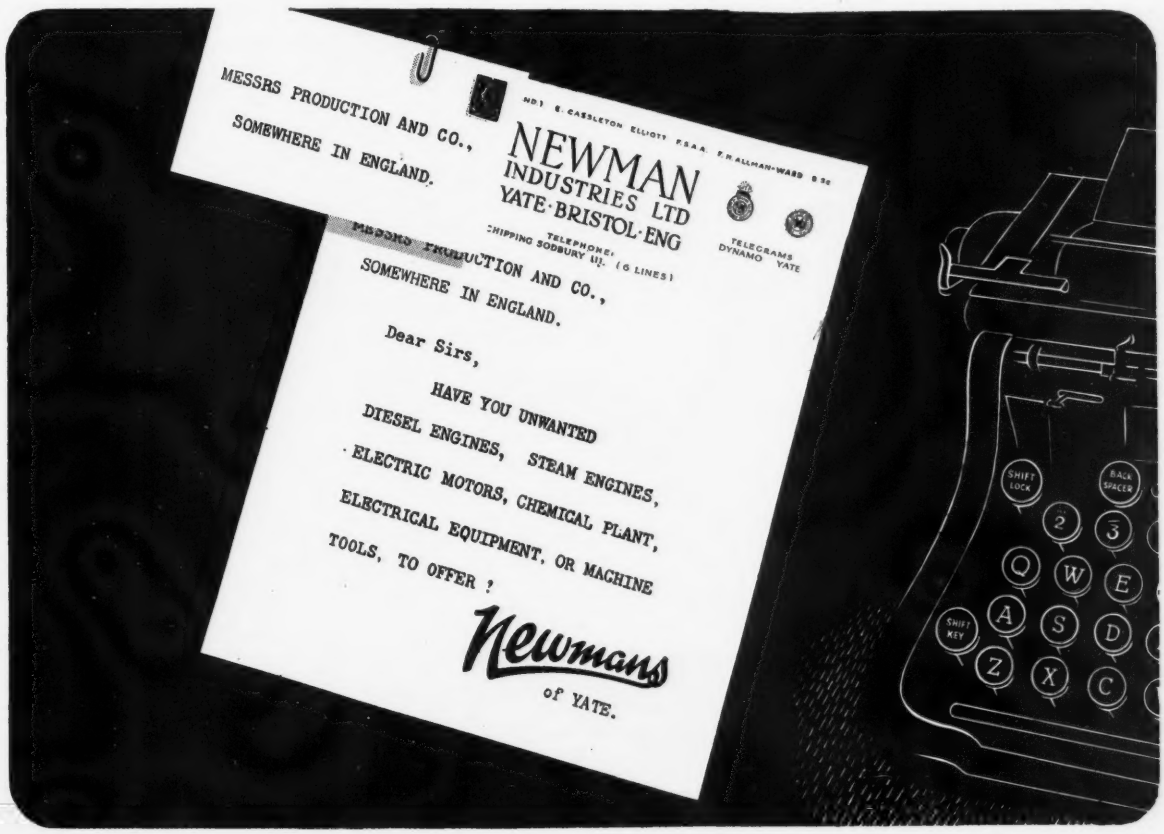

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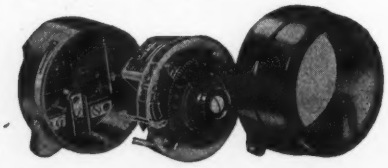

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Earth-Fault Protection

Need for Further Research

ON the principle that prevention is better than cure, it would be desirable to avoid the need for earthing by doing away with metal in an electrical installation other than that used for carrying current. This principle is recognised in the I.E.E. Regulations which strongly recommend the use, wherever practicable, of apparatus of the all-insulated type. Unfortunately, however, what is practicable in this way is very definitely limited.

Since metal must be employed in most instances, means have to be provided for preventing its being charged to such a potential above earth, due to leakage from live parts, as would cause risk of shock or fire. While the obvious course of securing this result by connecting metal to the main body of the earth is simple enough in broad outline, there is considerable difference of opinion as to the best methods of applying this doctrine.

There is, first of all, the need to cope with the paradox that an adequate earth connection of reasonably constant ohmic value is not always easily obtainable by making direct contact with the earth and that the indirect way of connecting with a public water system or the sheathing of cables is usually more efficacious. The requirements of adequacy include a low enough ohmic resistance to pass current of sufficient magnitude to operate the protective devices of the faulty circuit only.

Earth Return Sometimes Expensive

Perhaps the proposition would be more correctly stated as finding a path for leakage current back to its source, *e.g.*, the neutral point of the distribution transformer. To use the earth as a return conductor sounds a cheap way of doing this, but, as in so many engineering problems, the hope of getting something for nothing is illusory. Thus, in country districts served by overhead lines, where in default of cable sheathing or an extensive network of water mains reliance is placed on an actual earth return, the cost of using this "natural means" is often quite heavy.

Apart from the ordinary method of connecting the earth-continuity conductor of an installation to cable sheathing or water service, there are four methods of earthing, in common use, *viz.*, by electrodes, multiple earthing, neutralisation and earth-leakage trips. These were described in a paper recently presented by Dr. H. G. Taylor before the Association of Supervising Electrical Engineers. Regarding the first of these, it is now generally understood that the resistivity of the earth itself may be very high and that it may vary within wide limits with place and season of the year. It is only during the past two or three years, however, that the advantage of driving electrodes deep into the ground (as advocated previously by Dr. Taylor in our columns) has been appreciated in this country. Two other points which are not so widely recognised are made in the paper. One is that the resistance of the electrode does not necessarily increase with the current passed: the other is that its surface area is unimportant.

Risks of Multiple Earthing

Protective multiple earthing appears to be the method favoured by the author, who nevertheless recognises its chief weakness in risks consequent on the breakage of the neutral conductor. While he indicates measures to reduce the risks, we feel that further field investigations are called for before the system can be unreservedly commended. The same comment applies to "neutralisation," in which the framework of all apparatus is connected to the neutral at the meter board and not to earth.

The scope of the voltage-operated earth-leakage circuit-breaker still provides abundant matter for argument. Its merits have been stated on many occasions in our columns by Mr. T. C. Gilbert, who has recently contributed a paper to the I.E.E. on the subject. On the other hand, Dr. Taylor comes to the conclusion, after a reasoned exposition of its strong and weak points, that the sphere of utility of this device is somewhat restricted. It is evident that general agreement on earthing practice is still a long way ahead. Indeed, the complexity of the subject

grows as the currents taken by individual installations become larger. Nevertheless the subject is so bound up with safety of consumers and apparatus that further intensive research with a view to achieving finality will represent time and money very well spent.

Abstracts of I.E.E. Papers

IN an introduction to Part 2 of the first number of the new *I.E.E. Journal*, the chairmen of the Meter and Instrument and the Transmission Sections (Messrs. C. W. Marshall and H. J. Allcock) draw attention to the abstracts in Part 1 of the papers which are printed in full in the part under discussion. As Parts 2 and 3 will be sent only to those more closely interested in their specialised subjects and who make small additional payments, members as a whole will depend upon these abstracts for keeping in touch with such developments and should be able to trace them easily. At present the only guide is an omnibus reference to " Abstracts of Papers " in the table of Contents on the cover of Part I. Probably no more than another line of small type would be required to set out the subjects of the abstracts which would obviate the need to search through perhaps several issues in order to locate them. Another criticism is that a preamble, quite short, to each abstract, presenting the main conclusions reached, would save time in ascertaining the nature of the contribution.

Learning to Think

AN essential condition of retaining the ability to absorb knowledge is the acquisition of power to reject non-valuable information or at least to relegate it to the back of one's mind. In the journal of the Association of Mining Electrical Engineers, Mr. S. B. Haslam, its president, suggests that a function of practice is to assist this power of rejection. He is discussing the principles on which the examination for the A.M.E.E. certificate is based, but these apply generally to tests of engineering proficiency. The examination can be taken only after considerable practical experience, but while the self-discipline needed to prepare for entry is good in itself, there remains the difficulty that many men of the right type do themselves less than justice in written work. The candidate, therefore, is not judged on that alone. The oral examination (serving much the same purpose as the system of " interview " of candidates for the Royal Navy) gives him a chance of showing that he knows his job and that in addition to possessing technical knowledge he knows how to use it.

Unsatisfactory Coal Position

SPEAKING at last week's annual luncheon of the North-West England & North Wales Area Committee of the Electrical Development Association, Alderman W. Walker complained in strong terms of the way in which coal supplies for electricity supply undertakings were being handled. The Mines Department officials thought, quite erroneously, that three or four weeks' stocks were ample. He thought that E.D.A. should urge Members of Parliament to bring pressure to bear upon the Department to ward off any curtailment of electricity supply due to coal shortage. Alderman Walker was backed up by Mr. C. D. Taite who considered that any attempt to re-introduce gas and electricity rationing was unwarranted and unlikely to be of the least benefit to the country. In fact it would have an adverse effect upon the moral of the people. Granted that the pressure upon our railways is tremendous and that the need for man power is imperative, we consider that the fact that coal is the nation's life-blood should receive greater consideration from the Government. From the point of view of the mining industry itself it seems that the effect of the loss of export markets should be compensated for, or minimised, by ensuring the greatest possible output for the home market.

Conventions in Wartime

IN a recent issue the *Electrical World* (New York) discusses the propriety of holding electrical conventions in a time of emergency. Our contemporary says that annual meetings of associations have always played a big part in the industry's co-operation. Not only have the business sessions been of value, but the social and recreational side has been of untold benefit in building and cementing friendships that have proved their worth to the business many times over. The conclusion is reached that their is no reason why associations should cancel their annual gatherings this year although it is desirable to fit the programmes definitely to the problems of the moment. At present conditions here are, of course, vastly different from those in the United States and yet there is the same justification for association meetings if they can be arranged. Many circumstances combine to make national conferences impossible at the moment, but attempts should be made to organise regional meetings and this is a direction in which the Electrical Development Association might render valuable service. We are very glad that the Association itself is holding the usual luncheon and annual meeting this year.

Magnetic Storage Welding

PHASE-BALANCE and considerable reduction in voltage fluctuations during the spot-welding of aluminium are reported to have been achieved in the United States by the sudden release of magnetically stored energy. In the application of the principle, according to the *Electrical World*, an iron-cored reactor-transformer is partly saturated by current at 110-V from a rectifier supplied through a three-phase transformer. When saturation of the reactor has been built up to the degree required by the work in hand the primary circuit is automatically broken, and the stored energy is dissipated as a heavy surge of welding current in the low-resistance secondary. The claim is made that a 40-kVA unit will perform the same duty as a conventional 400-kVA single-phase welder and, if this is substantiated in further experience, the use in this way of what may be termed a " magnetic flywheel " should resolve many of the voltage difficulties with this class of load.

Electrification Justified

AT the annual meeting of the Southern Railway Company last week, the chairman (Mr. R. Holland-Martin) recalled the gloomy prognostications of opponents of the company's electrification policy that air raids would paralyse the system. He said that far from that being the case, it has actually proved of benefit in meeting the arduous conditions imposed by enemy action. In practically every case, after damage current has been available on the conductor rails as soon as the track has been restored and the use of multiple-unit trains has aided the company's operations.

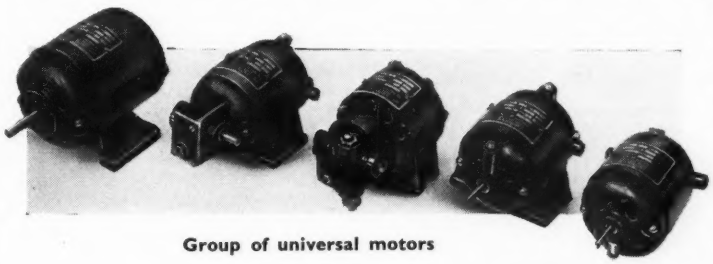
Universal Motors

Construction and Characteristics

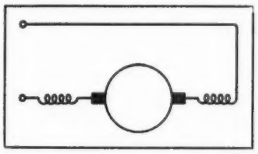
By S. F. Philpott
A.M.I.E.E.

IN point of numbers, the universal electric motor is the most used of all types, mainly because within limits of speed, voltage, frequency and size it gives approximately the same speed and power output on DC or single-phase AC circuits. For this reason it is widely used for all classes of domestic appliances, portable tools, office appliances and almost any small motor-driven machine that is sold over a wide area involving different systems of electricity supply.

The universal motor has several other advantages. Higher running speeds (up to 20,000 RPM) are obtainable than with any other type of AC motor. Speeds of 4,000 to 10,000 are most usual; below 4,000 RPM the "universal" quality becomes less pronounced. On account of the high running speed, together with the good efficiency and power factor (having regard to its small size) the universal motor develops more horse-power per unit of weight than does any other type, and this makes it particularly applicable to portable appliances. It gives a high starting torque—three to four times full-load in high-speed designs (it is less in lower full-load speeds).



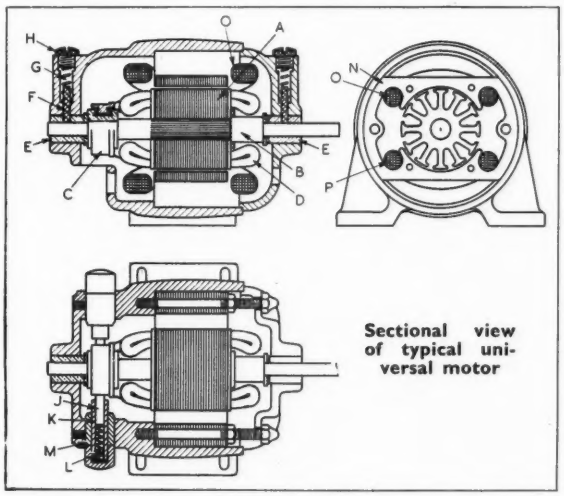
Group of universal motors



Connection of field coils in relation to armature

Since nearly all the appliances to which it is fitted are produced in large quantities, mass production methods can be applied to the manufacture of the motor itself for which its general design makes it suitable.

Special purpose tools are used extensively. For example, armature cores are frequently machine-built, the insulation being inserted automatically; the armatures are often wound automatically from start to finish and even such work as the fluxing of the commutator prior to soldering, may be done by machine.

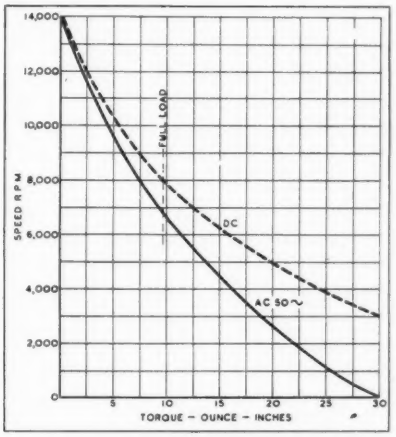


Sectional view of typical universal motor

Except that the field system is laminated and that the ratio of field to armature ampere turns is different, the universal motor is in its most common form of up to about $\frac{1}{3}$ HP, similar in construction to the series-wound DC motor. Above that size the field system is usually modified and it is only in exceptional cases that universal motors of about $\frac{3}{4}$ HP are made.

In the accompanying sectional view of a typical universal motor the armature stampings "A" are pressed on to shaft "B." "C" is the commutator, usually mica insulated, although bakelite construction, which is much more reliable than was the case a few years ago, is used to some extent. The armature winding "D" is usually wound direct into the insulated slots, generally by machine, and not former-wound as for larger machines. Double-silk covered wire is often employed on account of its good space factor, enamel being used to a smaller extent for the same reason. Cotton-covered wires are used in the larger sizes of armatures.

The shaft runs in bearing bushes "E" of phosphor bronze; the latter may be of the graphite oil-impregnated type, which has become popular on account of the little maintenance required. Although impregnated bearings are claimed to be capable of running for long periods without lubrication, in the application to small high-speed motors, some form of lubricator is usually provided. Ball bearings are also frequently used.



Performance curve of typical machine

For phosphor-bronze bearings, lubrication is provided by the oil-soaked wick "F," which is pressed against the shaft by means of spring "G," oil being fed from time to time through cap "H." The carbon brushes "J" slide in brass tubes "K" and are pressed against the commutator by spring "L." The brush tube is insulated from the bracket by a bakelite tube "M."

The field magnet "N" is built up of laminations riveted together and mounted in the shell, which may be cast iron, a die casting in zinc-base alloy, a steel pressing or moulded in bakelite. There are two field coils "O" and "P" which are connected in series with each other and with the

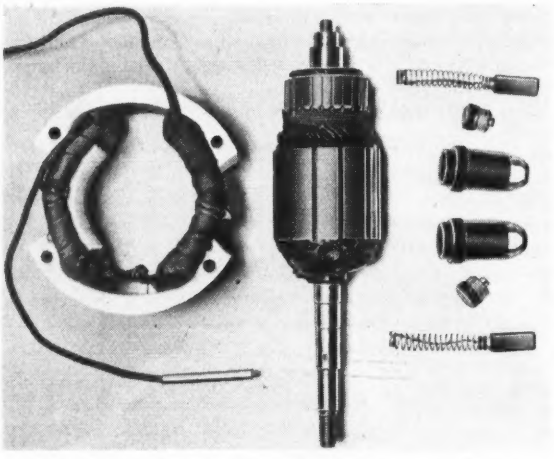
armature. To give a simple construction, it is usual to sandwich the armature between the field coils.

In the larger sizes of universal motor the same principle of construction is followed, except that the field is slotted similarly to the stator of an induction motor instead of having two salient poles and, in addition to the main winding, which usually occupies only one or two pairs of slots per pole, there is a compensating winding at 90 deg. to the main winding, the object of which is to neutralise armature reaction, thus improving the performance in general and the commutation in particular.

A disadvantage of the universal motor, for some applications is its series characteristic, its speed varying widely with load and with voltage. Theoretically, the speed rises to infinity at no load but in these small sizes it is usually limited to a safe figure by windage and friction losses. If constant speed under varying loads is required a special form with a governor is used.

Obtaining Similar AC and DC Performance

No universal motor has exact similarity of performance on DC and AC, because of the higher impedance of the winding with the latter and, therefore, the lower horse-power output for a given speed. To obtain like performance, the reactance drop of the windings must be kept low, and the difference between the flux in the two cases must be as small as possible. Within certain limits the reactance drop can be adjusted by design. By keeping the product of flux and field turns low, the reactance drop can be kept proportionately low. This condition calls for a smaller reluctance in the fields and a small air gap; this giving a " weak-field " motor. In the majority of appliances to which the universal



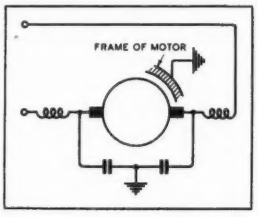
Armature, field coils and other components

motor is fitted, some disparity in full-load speeds on DC or on AC does not matter, but where nearly exact similarity of performance is important either a variable resistance or a field winding tapped to provide less than the whole for AC operation is required.

The universal characteristic is limited by speed, as similarity of performance becomes less as the speed falls below full load owing to the increased reactance voltage on AC caused by the increased current taken. Except in special designs a single winding can generally be made to cover DC and AC on frequencies up to about 60 cycles. Above 60 cycles, the inductive reactance of the winding, which is proportional to the frequency, increases to such an extent that a specially designed motor is generally found to be necessary.

Similarity of performance on DC and on AC is also controlled to some extent by the required full-load speed of the motor and is best obtained at speeds between about 5,000 and 10,000 RPM. Generally speaking, the lower the full-load speed, the greater is the divergence between DC and AC, and below about 3,000 RPM, the divergence becomes very great, particularly in very small outputs. The most satisfactory all-round speed for a universal motor lies between 6,000 and 8,000 RPM. Normally, where slow operating speed is wanted, a high-speed motor is used and is fitted with a reduction gear.

Owing to the series characteristic and to unavoidable slight manufacturing differences, such as fit of bearings, pressure and bedding of the brushes on the commutator or of the lubricating wick on the shaft, the speed at full load varies from motor to motor of nominally the same output and horse-power. This variation does not greatly matter in the majority of applications, and a tolerance of plus or minus 20 per cent. of the standard rating, is generally acceptable. If a closer rating is required, a governor-control motor must be employed, by means of which margins of within ± 1 per cent. or less can be maintained.



Method of suppressing radio interference

Universal motors can be designed to give approximately identical performance at any voltage between about 50 and 250, but few are built for more than 250 V on account of insulation and commutation difficulties. At the lower end of the range, as the impressed voltage is reduced, the load current and the transformer current increase to the extent that below about 50 V (50 cycles) it is difficult to provide a sufficiently large brush area with the requisite contact resistance to limit the transformer current, which flows in those coils of the armature momentarily short-circuited by the brushes, without causing serious overheating of the commutator. The demand for such low-voltage motors, is of course, very small.

If, in addition to making the motor universal as regards its ability to run either on DC or AC it is also desired to make it universal as regards voltage, it is usual to wind the machine for some lower voltage, say 100, and provide an adjustable series resistance to cover a voltage range from 100 to 250.

Like other fractional horse-power motors, the efficiency of the universal motor is low compared with that of large motors. It varies from 25 to 60 per cent. according to size of motor, a fair average being 50 per cent. However, owing to their small power output, efficiency is of little moment, especially in appliances intermittently used, compared with the utility obtained from the driven machine. The power factor of universal motors varies usually from 0.7 to 0.95 at full load.

Maintenance Factors

Wear of brushes places a universal motor at a disadvantage in comparison with an induction machine, but its intermittent use in most cases prevents servicing assuming serious proportions. Nevertheless continuous development of electrical design and careful selection of brushes coupled with attention to manufacturing detail such as bearing fits and finish, diamond turning of commutators and dynamic balancing, have done much to minimise commutator maintenance, and many modern universal motors are quite suitable for continuous duty.

Commutation conditions and hence brush wear are worse for AC than for DC running, because of the presence of a transformer voltage generated in the short-circuited coils by the alternating main-field flux, which causes a local short-circuit current to flow, possibly several times the value of the load current. This is one of the chief causes of the inevitable additional sparking which takes place when a universal motor is run on AC, as compared with DC opera-

tion. This extra sparking contributes to more rapid brush wear than is the case with DC machines. Another disadvantage of this type of machine, again due to the commutator, is its liability to interfere with broadcast reception, but this trouble can be overcome by fitting a suppressor unit. When space permits, the suppressor is fitted as an integral part of the motor. In the usual method of radio-interference suppression used with universal motors, two condensers are connected in series across the brushes of the motor and their centre point is earthed; the field coils, one on each side of the armature, act as chokes.

The universal motor is rather noisier in operation than the induction type owing to the higher speed of working and to the brushgear. Quietness can be obtained by good mechanical construction and finish, care in the electrical design and in the selection and fitting of the brushes, and by dynamically balancing the armature. Silence is very important, because the greater proportion of universal motors are fitted to domestic and office appliances.

Post-War Electricity Supply

Organising the Development of the Domestic Load

By G. D. Bond,
D.P.A., A.C.I.S., Grad.I.E.E.

THE anticipation of reduced industrial supplies of electricity in the early post-war period, consequent upon the reorientation of the country's industrial efforts to peacetime activities, and the impossibility of obtaining a reduction in overall costs owing to the particular incidence of "fixed" costs in electricity supply, will undoubtedly force attention to the intensive development of the domestic load. A further impetus will probably arise from the surplus plant capacities that are expected to exist in selected generating stations (see Annual Report of the Central Electricity Board for 1939).

A national scheme of main-line railway electrification is possible but, even if plans were to be put into operation immediately after the war, some time would elapse before surplus generating plant would be reduced to a normal level. In any event, the benefits of such a scheme would not, under the present unsatisfactory state of electricity law, enure in any degree to the owners of those selected stations that would supply the load.

The Electricity (Supply) Act, 1935, has given the Board power in S.4. to supply traction requirements independently of the local distributor in whose area of supply the load is primarily taken, except that if the authorised undertaking owns a selected station, its consent is needed unless the Electricity Commissioners decide that this is unreasonably withheld. Undertakings which take their supplies from the Board at the grid tariff would, however, receive an advantage, inasmuch as the full utilisation of plant should tend to reduce the tariff charges in comparison with charges that would necessarily exist with a large surplus of generating plant.

After the war, as in 1918, there will be a surplus of generating plant which can only be loaded by intensive domestic development for which plans should be prepared now

The Order made under the Emergency Powers (Defence) Act empowering the Board to erect and operate generating stations may be the sharp end of the wedge to extend generally the Board's direction of selected generating stations to out-and-out ownership. Such an eventuality would tend to equalise over the whole supply industry the cost burden of surplus plant capacities existing in the post-war period.

Public generating stations are, however, at a serious disadvantage in competing with stations owned by railway companies, in so far as freight transport hereditaments receive the benefit of the derating provisions of the Rating and Valuation (Apportionment) Act, 1928. Similarly private generating plants are subsidised, since the benefit of derating is enjoyed by industrialists also. Derating of public supply systems would be of considerable assistance in the development of the industrial load in the post-war period and the claims of the supply industry should be incessantly pressed on the legislature.

The withdrawal of lighting restrictions will tend, although slightly, to counteract the contraction of industrial load after the war. Load transfer between evacuation and reception areas will not benefit the industry as a whole. It may even embarrass some reception areas.

An intensive development of the domestic load will offer the only general solution to the post-war problems of electricity undertakings, although in this there are likely to be serious difficulties. Limited supplies of raw materials and competition for skilled labour have increased production costs of domestic electrical appliances since the outbreak of war. The incidence of the Purchase Tax will double the burden of increased prices, although it may lead to some reduction in manufacturers' and wholesalers' profit margins in order to maintain for them an adequate market. The official policy of developing export trade and at the same time restricting by taxation the home trade in electrical appliances may well prove to be an attempt at squaring a circle.

Even if the Purchase Tax were withdrawn immediately upon the conclusion of hostilities (since its justification is the reduction of home consumption and encouragement of saving rather than the raising of revenue) a similar reduction of cost could not be expected in respect of other wartime increases, owing to the inertia of wage rates and general price levels. Even at pre-war price levels, many supply undertakings found it necessary to subsidise rentals of hired appliances from the price charged for the electricity consumed, in order to make any real measure of domestic progress. The increased costs of the post-war period will no doubt accentuate this difficulty of fixing attractive rentals as there is a limit to the subsidy that can be provided from electricity sales.

Some means must be found of producing such appliances as cookers, refrigerators, water-heaters and wash-boilers, so that they can be hired or sold at a price which will appeal to a wide body of consumers, possibly by the establishment of standard types through a pooling of knowledge and experience on the part of both manufacturers and supply undertakings. It would do much to minimise manufacturing costs if the supply undertakings as a whole would establish definite programme of requirements and bulk purchase under the auspices of such a body as the Electrical Development Association. It is essential, however, that any plan of this kind should be put into operation immediately upon the conclusion of hostilities.

Incidentally, the policy of E.D.A. in halving the subscriptions from member undertakings appears to be somewhat short-sighted in view of the financial resources that will be needed in the early post-war period for promoting public demand for electricity. It would be a good thing if E.D.A. were to assess the potentialities of each undertaking, including a survey of its prospects with existing distributing plant, with intensive development of specified areas and with general development.

No excuse would exist for failure to develop undertakings at least to the limit of existing potentialities. Generally, it would be difficult to justify the expense of general development, by which is meant the taking of load wherever it may be found. The economical plan, and from all points of view the more desirable one, is to develop intensively, area by area, planning a well-balanced load with regard to load factor and diversity. Areas should be selected for development according to their economic prospects and with a view to furnishing a reliable supply strictly within the authorised voltage limits and to making available easy-payment or rental schemes to meet the pocket of the working-class consumer.

The early post-war period will certainly prove to be a testing time for the public electricity supply industry and the measure of its success will be the extent to which the need for creative planning is appreciated now.

I.M.E.A. Activities

Annual Meeting and Council Nominations

IT has been decided by the Incorporated Municipal Electrical Association to hold the annual meeting on June 12th; it will be preceded by an extraordinary meeting for the purpose of amending the articles of association.

The Council has nominated Mr. J. W. J. Townley, of West Ham, as president of the Association for 1941–42 and Mr. F. Newey (Lincoln) has been nominated for the position of vice-president. Other nominations are as follows:—

Group "A":—Local authority representatives: Councillor H. M. Cassells (Barnsley), Alderman Capt. C. Saer (Fleetwood); Engineer representatives: Messrs. H. Breckell (Oswestry), P. Clegg (Macclesfield), A. J. C. DeRenzi (Newcastle, Staffs), A. J. Hutchinson (Farnworth), P. M. Maxwell (Batley) and D. Thomas (Abertillery).

Group "B":—Local authority representatives: Councillor M. Bloom (West Hartlepool), Alderman E. Kennedy (Scunthorpe), Alderman J. R. Potts (Carlisle) and Councillor B. J. Watson (Maidstone); Engineer representatives: Messrs. R. Birt (Ealing), W. D. Brassington (Motherwell), W. A. Royle (Sunderland) and F. Swarbrick (Hove).

Group "C":—Local authority representatives: Alderman G. B. Brooks (St. Marylebone), Councillor M. Scanlan (Glasgow), and Alderman W. Walker (Manchester); Engineer representatives: Messrs. F. F. Elliott (Woolwich), J. Mould (Leicester), A. J. Newman (Bristol) and L. Romero (Salford).

War Damage Bill

In commenting on the War Damage Bill, the *I.M.E.A. Journal* says that a deputation waited on an official of the Treasury when strong representations were made to secure the exclusion of public utility undertakings from the provisions of the Bill.

"It appeared from the discussion that little hope could be expected and, as is now known, the Bill will apply to public utilities. It only remains to point out that the Government did not accept the argument that it appeared to be better from an administrative point of view, for public utility undertakings to be dealt with, as a whole, by separate legislation. They intimated that the Board of Trade has power to take any person out of Part II of the Bill. If procedure could be simplified to secure greater efficiency in administration, surely cognisance should be taken of the views expressed by the various Associations who act on behalf of the public utilities!

"The Bill as applicable to public utilities will undoubtedly lead to a certain amount of confusion and, as strong representations will be made to convince the Board of Trade of the necessity for exclusion, it would seem, in the interests of all concerned, that the better course would have been to delete all reference to public utilities from the Bill. Of course it is competent for Parliament when promoting the further legislation referred to, to repeal the provisions of the War Damage Act in so far as they affect public utilities.

"The electricity supply industry would be satisfied if the Government would accept the basis of the scheme prepared by the Joint Committee of Electricity Supply Associations. This scheme has received full consideration by persons who it must be acknowledged are fully competent on account of their qualifications, to make provision in respect of war damage in such a way which appears to be fair, equitable and practical."

Kent Electric Power Bill

The I.M.E.A. Council is of the opinion that there are serious objections in principle to the Kent Electric Power Bill. In the first place it is considered that it is most inopportune at present to promote a Bill which is apparently bound to be of a most contentious nature, particularly as local authorities are, on account of their urgent civil defence duties, unable to prepare a thoroughly comprehensive opposition, and the Bill does not appear to be necessary or desirable in the interests of the successful prosecution of the war.

Also, it is stated, the question of the reorganisation of electricity distribution was under consideration by the Government before the war, and may well be revived thereafter, and it is undesirable to deal with this question piecemeal by way of Private Bill.

A communication was addressed to the Electricity Commissioners asking them to give the matter earnest consideration with a view to their reporting to the Minister in the terms expressed by the Association. A deputation also waited upon the Commissioners and elaborated the above objections. Sir Cyril Hurcomb stated that he would convey to the Minister the views which had been expressed.

Bulk Supply Charges

Recommendations made by Messrs. Kennedy and Donkin after investigations on behalf of the North-East England Centre of the Association were adopted by the Council and after negotiations with the North-Eastern Electric Supply Co. a satisfactory settlement was reached.

Undertakings in the area of the South Wales Electric Power Co. have been successful in arriving at a settlement with regard to charges for bulk supplies in that area.

The municipal undertakings in the area of the Mid-East England Centre of the Association are also of the opinion that action should be taken with regard to the charges for bulk supply in the area of the Yorkshire Electric Power Co., and the Council has decided to grant assistance similar to that granted to the North-East England Centre.

The Association considers it essential that the terms on which undertakers receive their supplies should be disclosed. It is said that undertakings are at a loss to understand why it is impossible to agree upon a standard basis throughout the country and it is argued that the only solution would be for supplies to be given at the grid tariff.

Large Arc Furnace

South African Steelworks Plant

AN instance of the way in which a wartime expedient may permanently establish an industry of importance is referred to in the *Journal* of the South African Institution of Engineers, wherein Mr. W. Wallace gives an account of the foundry owned by Chamber of Mines Steel Products, Ltd., whose membership is vested in 44 mines, which take 98 per cent. of the products, amounting to 30,661 tons in ten months of 1940. The previous year's total of 27,783 tons was produced at a cost of £281,058. The company commenced as the Witwatersrand Co-operative Smelting Works to manufacture shoes and dies by pressing owing to the shortage (in 1916) of imported steel. Steel balls for tubemilling purposes are also manufactured from billets cast in square section and rolled down in mills driven by 200 and 500 HP motors.

Other plant has included two one-ton induction furnaces in association with a rotary convertor generating two-phase current at 12 cycles; a two-ton and two five-ton arc furnaces of the "Efco" Heroult type, three-phase, with fixed roofs and arranged for forward tipping, operated from 1,500 kVA transformer banks under automatic control; and one ten-ton "Birlec-Lectromelt," which is the largest arc melting furnace in Africa. Its bowl capacity is 190 cu. ft. (8 long tons) and it is rated at 3,600 kVA at 2,000 V, three phase, 50 cycles.

It is cylindrical with a spheroidal lower segment, arranged to tilt 45 degrees for side pouring and 35 degrees backward for fettling and slagging. The doors are water cooled and pneumatically operated; the arched roof is lifted by a hydraulic ram and swung aside for top-charging with scrap metal by means of a drop-bottom bucket manipulated by overhead crane. Three 10-inch diameter graphite electrodes enter triangularly through the roof, under automatic control. Reducing the charge of the two five-ton furnaces from 6 to 5.25 tons has permitted a three-hour cycle with consequently greater output, averaging 1,200 tons each month. The power and electrode consumption averages are 577 kWh and 7·83 lb. per ton cast. The larger furnace averages 9 tons per cast and 8 casts per 24 hours, or a monthly total of 1,762 tons. The power and electrode consumption averages are 597 kWh and 8·75 lb. per ton cast.

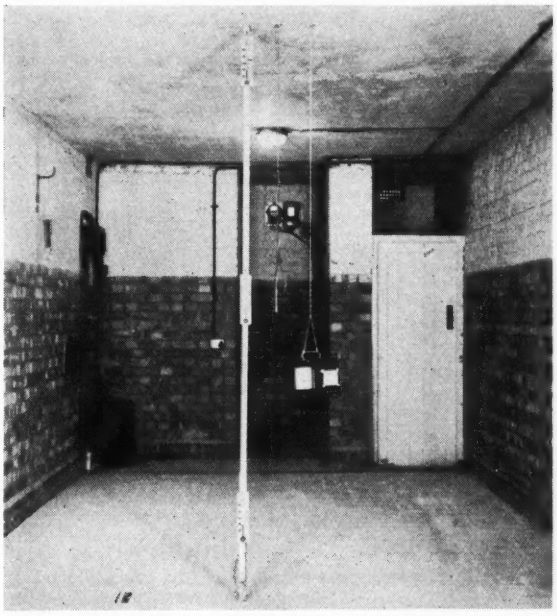
Shelter Heating

Experiments with Soil-heating Cable at Wembley

An account of results obtained by the Northmet Company with an effective and economical means of maintaining a comfortable temperature in a public shelter

INSPECTION of surface type A.R.P. shelters which are only sparsely occupied, usually induces a sensation of thermal discomfort, whether they are warmed by tubular heaters, natural or forced convectors, radiant fires, etc., or combinations of two or more types. Generally, this sensation of discomfort is found to be due to chilled feet and legs. In a Government publication, "The Warmth Factor in Comfort at Work" (Stationery Office, 2s. net) Dr. Bedford reported that the thermal conditions at floor level have a profound influence on the feelings of bodily warmth, and that the average temperature of the walls and other surrounding surfaces should not be appreciably lower than that of the air, but preferably higher. Furthermore the air at head level should not be distinctly warmer than that near the floor, and the heads of the occupants should not be exposed to excessive radiant heat.

With a rate of supply of metabolic heat energy of 400 B.Th.U. per hour, or 117 W from each shelter occupant, and the space provided in the shelter limited to 50 cu. ft. (minimum) per occupant, the fortuitous gain of metabolic heat energy is at the rate of 2.33 W (maximum) per cu. ft. This ratio is approximately twice the loading required to maintain a temperature difference of 30 deg. F. in a normal building.



The shelter at Wembley where the Northmet Co. has carried out its experiments with floor heating. Note the various temperature indicators and recorders

The problem of space heating in shelters therefore appears to resolve itself into the following factors :—Maintaining the thermal condition of the shelter at some pre-determined value that will induce a reasonable sensation of warmth in the earlier arrivals. Maintaining the specified sensation of thermal comfort during periods when the shelter is sparsely occupied, and there is only a partial gain of metabolic heat energy. Maintaining the structural surfaces above the dew-point temperature of the shelter during the unoccupied periods, in order to eliminate (so far as possible) the risk of condensation or sweating. Taking the supply of energy during off-peak periods, to enable nominal rates to be quoted for the load demanded. Restricting the temperature of the storage system (if any) so that the supply of heat energy to the shelter will cease immediately the shelter temperature commences to rise above the comfort limit, due to the supply of metabolic heat energy by people arriving in the shelter.

Considering these factors, the Northmet Power Co. arranged with the Wembley Civil Defence Department for the loan of a typical surface shelter scheduled to accommodate a hundred persons during the day and approximately sixty persons in bunks. The complete shelter is divided into two equal sections by a 9 in. brick wall, the internal dimensions of the half-section being 38 ft. 6 in. long by 10 ft. wide by 8 ft. high, *i.e.*, the heated space is 3,100 sq. ft. A chemical closet and anti-blast wall at each end restrict the length of the bunked space to 30 ft.

In view of the natural interchange of air per hour, it was considered to be unsafe to estimate for an air change less than three times the cubic capacity of the shelter per hour, and, bearing in mind the sensation of thermal discomfort induced by chilled feet and legs, it was decided to install a floor-warming installation, utilising standard soil-heating cable loaded to approximately 4.7 W per ft. Actually, a total of 700 ft. was installed, loaded to 3.27 kW. As 90 per cent. of the heat energy was expected to be effective, *i.e.*, 2.9 kW into the shelter, it was inticipated that this loading would maintain a temperature difference of 18 deg. F. between the unoccupied shelter and the external air.

Mr. R. Grierson, electric heating engineer to the Northmet Co., tells us that three methods of installing the cable in the concrete floor were considered, each of which involved the addition of a new surface of fine concrete approximately $1\frac{1}{4}$ in. deep, namely (a) Laying the cable on the existing concrete floor and then pouring the fine concrete. This method involves the removal and replacement of a section of the new surface in the event of a cable failure. (b) Forming wire-ways by casting well-greased and smooth-wall rubber hose-pipe in the new concrete, and attempting to withdraw it within 24 hours of casting, provided that rapid-hardening cement was used. Temporary expansion of the hose by hydraulic pressure was also discussed, in order to facilitate removal after the concrete had set and the pressure was released. (c) The formation of a series of slots, by casting well-greased $\frac{3}{8}$ or $\frac{1}{2}$ in. wide by $1\frac{1}{4}$ in. deep battens or steel strips, in the new surface and removing them when the concrete had set. With this method, the cables would have been laid in the slots, the slots filled with sand to within $\frac{1}{2}$ in. of the top, and the slots finished with a mixture of sand and cement. In order to save time, the first method was adopted. The cables were laid at 4 in. centres, so that the actual floor-loading is 14.1 W per sq. ft., and the total warmed area is 240 sq. ft.

Temperature observations for a typical day, when a minimum night temperature of 39 deg. F., a 9.0 a.m. temperature of 42 deg. F. and a 3.0 p.m. temperature of 49 deg. F. had been recorded were as follows :—Warmed floor, 70.0 deg. ; unwarmed floor, 57.5 deg. ; external wall, 61.0 deg. ; partition wall, 62.5 deg. ; ceiling (internal surface of concrete), 62.5 deg. ; mean radiant temperature of structural surfaces, 62.8 deg. ; dry-bulb air temperature in shelter 60.0 deg. ; globe thermometer, 61.5 deg. ; sub-soil at 12 in. below floor surface, 67.0 deg. and sub-soil at 3 ft. 6 in. below floor surface, 58.0 deg.

For the first ten days after commencing the heat run, considerable difficulty was experienced through excessive condensation of moisture on the ceiling. Investigation of the five 9 in. by 6 in. terra-cotta or baked clay air-bricks fixed at high level, under the roof slab, proved that they only provided a clear airway of 0.243 sq. ft., or a ratio of net to gross area of 13 per cent. The most optimistic view of the probable air velocity indicated a value of 2.2. ft. per sec. or 7,900 ft. per hour. (1.5 MPH) which represents a total volume of 1,920 cu. ft. per hour, and a shelter air change of 0.62 times per hour. A window-type of fan was then installed and the duty adjusted to induce a positive air movement through the shelter of 13,000 cu. ft. per hour. representing 4.2 changes per hour.

As the rate of transmission of heat energy was estimated to be 3.66 kW to maintain 20 F. difference, the estimated consumption

for the week would be 81.5 per cent. of 3.66 kW × 168 hours= 500 kWh with three air changes. Actually, with 4.2 air changes maintained, the energy metered in the unoccupied shelter (*i.e.*, without metabolic heat gains) was 437 kWh, or 87.5 per cent. of the estimate. For an occupied shelter it is estimated that 24 kWh a day would be sufficient.

An interesting feature of the installation is the heat energy stored in the concrete floor slab and in the sub-soil beneath it, the temperature at 3 ft. 6 in. below floor-level now being 58 deg. F. This storage enables a three-hour peak load restriction to be applied to the supply, without any very material effect on the equivalent temperature of the shelter.

Another important feature of the installation is that the soil-heating cables being buried in the concrete cannot easily be interfered with or removed.

Mr. A. H. Watson, superintendent of the Northmet Western Area states that the cost of an installation in a new shelter (not involving relaying of the floor) is about £15.

PERSONAL and SOCIAL

News of Men and Women of the Industry

THE Ipswich Corporation has now approved the re-organisation scheme submitted by **Mr. G. A. Vowles,** M.I.Mech.E., A.M.I.E.E., chief engineer and manager of the Electricity Supply and Transport Departments, and the following are the more important of the new staff arrangements to operate from April 1st: On the generation side, Mr. R. O. Martin will relinquish his part time duties as trolley bus rolling stock superintendent, and will be wholly employed as power station superintendent, grade 3. Mr. H. B. Campbell, assistant power station superintendent, becomes personal and technical engineering assistant to the chief engineer, grade 3. Mr. J. Boon is promoted to operation engineer, grade 6, and a new post of power station junior engineer, grade 9A, is to be created and filled by promotion from existing staff. On the distribution side, Mr. C. L. C. Allan, B.A., A.M.I.E.E., as we reported in our last issue, has been appointed assistant mains superintendent, grade 5, while the following are to be redesignated :— Mains engineer, grade 7 (Mr. J. B. Kerr); substations engineer, grade 7 (Mr. Q. F. Parker); district engineers, grade 8 (Messrs. M. Brasnett, F. M. Poole, R. A. Powell and F. A. Reeve). Mr. W. H. Howell has been designated showroom superintendent at a salary in accordance with the Council's grading scheme, and Mr. G. H. Blackburn, installation superintendent, is to be relieved of any responsibilities in connection with the showroom management. Mr. R. Chandler, traffic assistant, becomes assistant traffic superintendent, with salary in accordance with the Council's grading scheme.

Mr. C. Heathcock, F.C.I.S., whose appointment as vice-chairman of the West Midlands Joint Electricity Authority was reported in our last issue, was a member of the Conference of electricity undertakings which resulted in the establishment of the Authority in December, 1925, and he is an original member of the Authority. He held for some years the positions of secretary of the District Joint Board (No. 5 District) West Midlands Area, and of the District Industrial Council (No. 5) West Midlands Area. He is a member of the Council of the Chartered Institute of Secretaries and is managing director of the Midland Electric Corporation for Power Distribution, Ltd.

Mr. C. Heathcock

Mr. A. P. Trotter, B.A. (Cantab.), M.Inst. C.E., M.I.Mech.E., a past president of the Illuminating Engineering Society, has been elected an honorary member of the Society.

The George Medal has been awarded to **Mr. G. H. Whelton,** station superintendent with the London Power Co., Ltd., who, when an explosion occurred in a switch and transformer house as a result of indirect enemy action, connected the fire extinguishing apparatus, having to traverse areas awash with burning oil, and eventually the fires on ground level were brought under control. Mr. Whelton, at extreme risk, also climbed into the roof and along the supporting steel work to deal with another outbreak. It was necessary to make three attempts before the fire was extinguished.

Mr. G. R. Abel, charge engineer and **Mr. R. S. Parsons,** fitter driver with the Stepney Borough Council, have been officially commended for their conduct during recent air raids.

Mr. E. Harlow has had to resign his position with the City of London Electric Lighting Co., Ltd., owing to ill-health. He has completed forty years' service with the company at the Bankside power station, being station superintendent from 1909 to 1931 and becoming station engineer in the latter year, a position which he held up to the time of his retirement.

Mr. R. C. Fox, A.M.I.E.E., head of the Electrical Engineering Department of the North-Western Polytechnic, Kentish Town, N.W.5, has been appointed principal of the Technical School, Lisburn, Northern Ireland.

Mr. E. F. J. Holcombe Hewlett, for thirty-five years borough electrical engineer at Mansfield, and Mrs. Hewlett, celebrated their golden wedding on March 4th. Mr. Hewlett was the borough electrical engineer from 1902 to 1937, when he resigned and was then retained in a consultative capacity.

The Staffing Sub-Committee of the Electricity Committee, Stoke-on-Trent, has recommended that the salary of **Mr. T. Lockett,** manager of the electricity undertaking, be increased from £550 to £750 per annum and by further annual increments of £50 to £1,000 per annum. The Sub-Committee also recommends that **Mr. L. Goodall,** engineering assistant, be regraded, his salary to be increased from £498 to £576 per annum.

Mr. R. Mackenzie, B.Sc., has been appointed maintenance engineer to Edinburgh Transport Department. Mr. Mackenzie, who is thirty-one, received his theoretical training in Keil Technical School, Dumbarton, and at the University of Edinburgh, where, in 1932, he graduated B.Sc. with first-class honours in engineering, and received the medal in the Honours Class of Advanced Heat Engines. He served in the workshops of Edinburgh transport undertaking and has been successively assistant bus engineer and assistant maintenance engineer.

Mr. C. Cameron, A.M.I.E.E., late of Ferguson, Pailin, Ltd., has taken up an appointment as temporary electrical inspector of factories with the Ministry of Labour and National Service.

Mrs. A. Leevers has been re-elected chairman of the London Branch of the Electrical Association for Women, and **Mrs. B. Jolley** has also been re-elected hon. treasurer. Mrs. Bonell, Mrs. Sargant and Mrs. Watts have been elected to the Executive Committee. The Association has arranged a whist and bridge drive in aid of the Electrical Industries Benevolent Association, which will be held at 20, Regent Street, S.W.1, on March 25th, at 1.30 p.m. Tickets (1s. 6d. for members and 2s. for non-members) can be obtained from the secretary of the London Branch. Those who are unable to attend may send donations (not exceeding the price of a ticket) to the secretary. Mr. J. N. Stephens, chairman of the E.I.B.A., will give a short address on the work of the Association.

Mr. W. B. Hayden, A.M.I.E.E., deputy borough electrical engineer to the Epsom and Ewell Corporation, has been appointed borough electrical engineer in succession to Col. H. W. Watts, who retired on March 8th.

Mr. R. G. J. Nisbet, who was recently appointed sales manager of S. Wolf & Co., Ltd., was apprenticed to a well-known Scottish engineering firm and was representative for Scotland and the North Eastern Counties of S. Wolf & Co. for three years. He has since acted as assistant sales manager.

Mr. R. G. J. Nisbet

Mr. J. E. Nelson, M.I.E.E., of the Mersey Power Co., was elected chairman and **Mr. J. H. Lumsden,** M.I.Mech.E., vice-chairman, at the annual meeting of the North West England & North Wales Area of E.D.A., held at Manchester, on March 11th.

Obituary

Mr. J. D. Pember.—We regret to learn of the death of Mr. John Digby Pember which occurred at Poole, on February 24th, at the age of sixty-eight. Mr. Pember was educated at King's School, Worcester, and Finsbury Technical College, and received his practical training with the Great Western Railway and with Crompton & Co., Chelmsford, after which he entered the electricity supply industry, being successively chief assistant at York and electrical engineer at Farnworth and at Dartford respectively. In 1919 Mr. Pember went to Bombay as superintending engineer to E. D. Sassoon & Co.'s group of mills. He remained with this firm until his retirement eight years ago.

Wills.—Mr. G. H. Nisbett, deputy chairman of British Insulated Cables, Ltd., and chairman or director of a number of other companies, left £142,817, with net personalty £128,618. He left £1,000 to the benevolent fund of the Institution of Electrical Engineers.

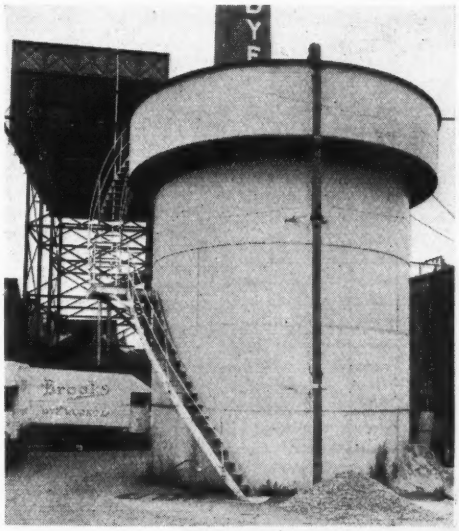
Mr. Andrew Bell, electrical engineer, Perth, left £9,974.

Soft-Water Storage

Electrically-operated Plant at a Laundry

APART from plants operating on the base exchange principle, it is surprising to note the number of lime-soda installations which once put into commission receive inadequate attention. The necessity of eliminating oil and grease from boiler feed water is, of course, well recognised and reasonable care is generally exercised to safeguard the boiler plant against the detrimental effects of such forms of contamination, but the same observation does not apply in respect of excessive alkalinity, which may give rise to equally undesirable results, such as caustic embrittlement.

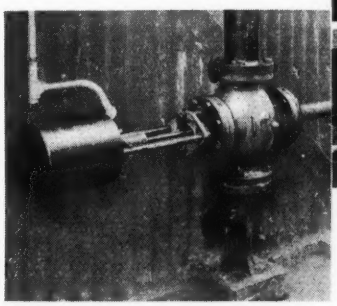
The quality of soft water required for processes is also a matter of extreme importance in many industries, especially laundries. Excessive alkalinity in the soft-water supply is extremely undesirable. This may be due to incorrect operation of a lime-soda plant, but in many cases the overloading of the plant is the cause, the sedimentation period being thereby adversely effected. The difficulty has been overcome at Brooks' Dye Works, Ltd., the West of England launderers and dry cleaners, by the adoption of electrically-operated equipment which enables soft water to be stored at night for supplementing the supply to the extent required. This is believed to be



Lime-soda sodium aluminate water-softening plant with main storage tank

the first time that an existing installation has been adapted in this manner. Crude water is pumped from a brook adjacent to the laundry and passing through the plant is dealt with as required and finally discharged to the main 55,000-gal. storage tank. Due to increasing demand for soft water by the wash houses, this plant became overloaded and the sedimentation period was so reduced that excessive alkalinity resulted. Under normal working conditions, the plant continues in automatic operation after working hours for the purpose of filling the main storage tank to meet the following day's demand. This tank becomes filled at about 11 p.m., when the float switch fitted closes down the complete installation for the night.

It was found that one of the flat concrete-lined roofs of the building could, at small expense, be utilised as an overhead water storage tank of considerable capacity.



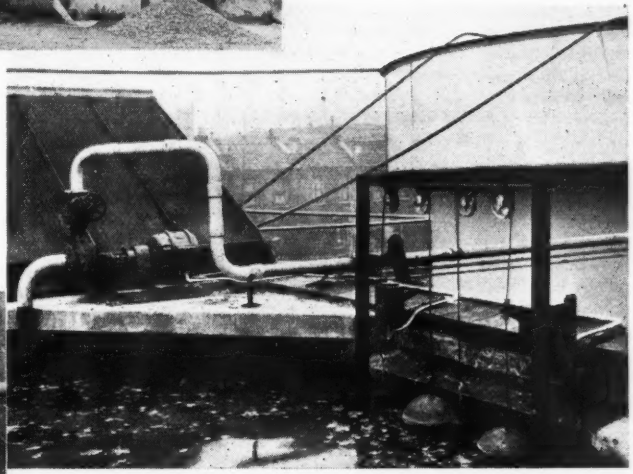
A Verity-Worthington direct-coupled booster pump, controlled by a float switch, forms part of the auxiliary storage equipment. A new pump house has been erected and the plant is protected from frost by tubular electric radiators. The function of the booster pump is to discharge water from the storage lake to the 55,000-gal. tank, thus giving adequate head to the wash house, an item of considerable importance, since the washing machines have to be filled with the least possible delay.

At about 11 p.m., when the 55,000-gal. tank is on the point of being filled, the float-switch equipment throws a motorised two-way valve supplied by E. A. Controls, Ltd., direct on to the line and diverts the discharge of treated water from the main storage tank to the roof tank, the whole plant then continuing to operate until the roof tank is filled.

The roof tank being filled, the float-switch equipment again operates, closing down the plant as a whole and at the same time reversing the motorised valve so that it is in position for discharge to the main tank for normal operation the next morning. When the water level in the main tank has been sufficiently reduced, the booster pump comes into operation and discharges the stored water from the roof tank into the main storage. The whole equipment is entirely automatic and requires no attention day in, day out. Without overloading the water softener an adequate supply of soft water of excellent quality is available at all times as required for process.

The capacity of the steam raising plant has recently been increased by the installation of a new self-contained "Economic" boiler by Edwin Danks, Ltd. A Hodgkinson mechanical stoker and a Musgrave induced draught fan are driven by Veritys induction motors; in the former case the motor is of the change-pole type for speed control. This plant includes a Lea coal meter, CO_2 indicator and recording thermometers to register flue-gas and hot-well temperatures. A water meter registers the discharge to the boiler from a Weir pump taking feed from an elevated hot well, which gives the required static head to the suction side of the pumps, thus ensuring efficient operation with condensates at the comparatively elevated temperature of 200 deg. F.

Complete reconstruction of condensate discharge arrangements have also been undertaken. Three main under-



New supplementary storage tank on roof showing booster pump and float-control switch, and (left) electrically-operated change-over valve

ground condensate pits have been built at convenient points, each with a reception tank and Verity-Worthington direct-coupled centrifugal pump controlled by a float switch. These return the condensates available to the main hot wells. As a result of the installation of Bailey steam meters each important department may now be debited with the steam it takes.

For lighting "Maxlume" mercury fluorescent discharge units have given every satisfaction. The main contract was undertaken by the Brightside Foundry & Engineering Co., Ltd., to the specification of the consultant, Mr. G. T. Champion, A.M.I.Mech.E.

CORRESPONDENCE

Every letter must be accompanied by the writer's name and address preferably, but not necessarily, for publication. The Editors cannot accept responsibility for correspondents' opinions.

The First Searchlight Battery

IN your issue of March 7th, there appeared a letter from Major B. G. Drummond, R.A. The letter in parts is correct, but a record has been compiled by Major Leeds, R.E. (T.), late of Crompton Parkinsons, based in part on records (1902 to 1908) provided him by myself, a late member of the Electrical Engineers, Royal Engineers (Volunteers), and an original member of the Essex (Fortress) Royal Engineers (an off-shoot of the volunteer unit). It might be said that Colonel Crompton's unit was the mother of the existing host of searchlight units.

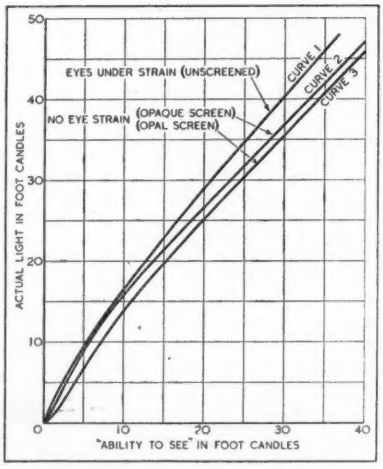
After the last war a great many changes took place, some elements of the Territorial company came under gunner control, others became Searchlight Companies, R.E. I suggest that your correspondent applies to Major Leeds. I have further scrap books in my possession here at home, dealing with the period after 1908 until the end of the last war.

Reading, *March 13th.* E. A. RUST.
Late Lieut. R.E. (T.), and " Old Cromptonian."

Factory Lighting

In response to a request from a reader of my letter in the ELECTRICAL REVIEW of February 21st, may I amplify the information I then gave ?

The proof of my theory that perfectly screened light is more efficient than unscreened light will be more clearly seen in the accompanying graph in which I have plotted ability to see against actual light. Obstructive glare — the insidious evil which is the root cause of untold ill-health and defects of vision — militates against the proper and full functioning of the ability to see and renders it necessary in assessing light values to make appropriate reductions on account of the effect of glare on the eye. Hence light curves given by makers of lamps and fittings from which there is glare in any degree are liable to be misleading.



Curves illustrating effect of efficient screening

In this graph, which has been prepared from actual lightmeter readings, the poorer efficiency of the unscreened light is shown by comparison with the two curves obtained by the use of simple screens which I have devised. It is very much to be hoped that the very good instructions given in Paragraphs 4, 5 and 6 of the Fifth Report of the Departmental Committee on Lighting in Factories will be fully enforced.

Barrow-in-Furness, *March 5th.* ROBERT CALDWELL.

Instrument Bearings

We have read with interest the article on " Instrument Design " in your issue of January 17th. At the end of this article, at the bottom of page 256, a paragraph is devoted to a discussion on the use of alternative bearings in instruments. The statement is made that the permissible limits of error in instruments have been increased by 100 per cent., and that this increase applies to instruments fitted with substitute bearings. This statement implies that the 100 per cent. increase in permissible errors was introduced *because* of the use of substitute bearings. This is, in fact, definitely not the case and should be clearly understood.

The increase in permissible errors was made solely in the interests of increased production, one important factor in achieving this being the possibility to use predetermined scales on instruments. The inaccurate statement in the article in question is emphasised more strongly by the fact that it is given prominent editorial reference in which the statement is carried one step further by saying that the increase in permissible errors is because of the substitute bearings.

For your information, we enclose herewith a short note on " Alternative Bearings for Instruments " written by our chief engineer who has been carrying out considerable development work on these bearings.

Enfield, *March 7th.* SANGAMO WESTON, LTD.
E. A. DYMOND, Director.

[The note referred to as having been prepared by the company's chief engineer, Mr. F. R. Butherus, relates to the lubrication of bearings and the manufacture of synthetic jewels, explaining the meaning of " glass " bearings (for want of a better term) and indicating the degree of accuracy obtainable, judged by numerous tests made over long periods—EDS. ELEC. REV.]

Mr. J. F. Stanley (B.S.I.) the author of the article in question, who has seen Mr. Dymond's letter writes as follows :—

In reply I would refer to the War Emergency Revision of B.S.S.89 which was issued by the British Standards Institution in December last, the first paragraph of which reads :—

> " It having been found necessary in certain instances to provide for substitute bearings in first-grade instruments, the following addenda to the above specification are introduced as a war emergency measure."

It will be appreciated that my article was dealing specifically with B.S.S.89, and it may be that what Mr. Dymond has in mind is that certain easements have been agreed upon between the instrument manufacturers and Government Departments with regard to the instrument specifications issued by those Departments. I understand, however, that almost without exception the instruments to which the easements apply are those which may have substitute jewels. Whilst the Services can discriminate between instruments according to the particular Government specification to which they are to comply, this is not possible in the case of B.S.S.89, and it was presumably necessary to lay down some characteristic which would justify the relaxation of accuracy. The characteristic selected was the use of substitute jewels, as is shown by the extract from the War Emergency Revision of B.S.S.89 which I have already quoted.

London, S.W.1, *March 11th.* J. F. STANLEY.

Enemy-owned Patents

The position with regard to enemy-owned patents under the War Emergency Act appears to call for some explanation in order that it may be properly appreciated by British manufacturers. First, it is quite wrong to assume that such patents can be infringed with impunity, because anyone may apply to the Comptroller for the grant of an exclusive or a non-exclusive licence to use the patent, and this entitles the licensee to take the place of the patentee in regard to suing for infringement. Consequently, it is important for manufacturers to apply for licences under any enemy-owned patents which they wish to use, if only to safeguard their freedom to use a patented invention should a rival firm apply for a licence under the patent.

Furthermore, the licences granted by the Comptroller are not necessarily limited to the duration of the war, but may be granted for the remaining life of the patent. This is important, because it means that a firm putting in special plant, or building up a good business under an enemy-owned patent, will not have to discontinue using the patent at the end of the war, which it would otherwise have to do should the enemy owner of the patent refuse to continue the licence after the war. If a War Emergency Licence is not obtained from the Comptroller, however, the firm would in such circumstances have to discontinue using the patent after the war, for fear of infringement proceedings.

London, W.C.2, *March 12th.* CHAPAG,
Chartered Patent Agent.

INSTITUTION PROCEEDINGS

Faraday Lecture. Insulation Characteristics

Electric Traction

THE annual Faraday Lecture of the INSTITUTION OF ELECTRICAL ENGINEERS was delivered at the North-Eastern Centre, Newcastle-on-Tyne, on March 12th (it is not being repeated elsewhere this year) by Mr. C. E. Fairburn, of the London, Midland & Scottish Railway Co.

He mentioned that, contrary perhaps to the general belief, the first experiments with electric traction were made only a little later than those with steam traction on railways. Those early experiments were, however, premature, as the principles of electricity were very incompletely understood, and it was not until Faraday and several other investigators, working from about 1829 to 1840, enunciated the fundamental principles that development became possible.

The early experimenters, for lack of other sources of energy, had relied upon batteries, and from the time of Faraday onwards various attempts were made to develop an electric vehicle, but it was not until 1879 that a successful model was produced. It was exhibited at a trade exhibition, and its success led immediately to the construction of a short public tramway on the Continent. The first electric traction systems installed in the United Kingdom were those at Brighton and Portrush in 1883. From then onwards electric traction progressed rapidly.

The lecture dealt almost entirely with progress in Great Britain and with the essentials of present-day practice. Improvements in the equipment effected in recent years were described and stress was laid on the simplification which had been achieved. The door-opening and closing equipment which replaced the attendants on the early London Underground trains was now finding its way on to the main-line companies' trains. What was not so obvious, however, was the reduction in weight that had taken place in electric rolling stock and the economies which followed from this.

Although so far the motor coach had been used almost exclusively in this country, other countries employed locomotives of considerable size, and a more general application of electric traction to the railways of this country would result necessarily in a much greater use of locomotives.

It might sometimes be felt that compared with other countries developments here had been slow. But it must be realised that much of the development abroad was the result of special circumstances; for example, an abundance of water power or geographical reasons, such as heavy gradients and long tunnels in mountainous country. In Great Britain as coal was good and cheap, electric traction had to compete with steam traction.

The lecture was illustrated by a number of slides and was followed by a short film illustrating the operation of electric traction on the London, Midland & Scottish Railway.

Insulating Materials

SOME of the physical properties of commonplace substances, which suit them to electrical insulation needs, are commented upon in a paper prepared by Mr. P. C. Walmsley (Micanite & Insulators Co., Ltd.), for presentation at a cancelled meeting of the ASSOCIATION OF SUPERVISING ELECTRICAL ENGINEERS that was to have been held in London this week.

After explaining the B.S.I. method of classification for specification purposes the author had intended briefly to speak of the different ways in which various materials are produced commercially, so as to indicate the relative importance of those characteristics which guide selection for different uses.

For instance, he considers the indifferent demand for artificial silk insulation to be due to price factors and performance that is inferior to that of the natural product. Strides are most apparent in untreated insulating papers, makers having eradicated non-uniformity in structure and thickness. Cotton and kraft (sulphate treated wood pulp) are mostly employed for wrapping and as spacers, subsequently impregnated; manilla and jute were of limited application, principally as reinforcing agents. The utility of paper pressboards, presspahn and similar materials when correctly applied is beyond question in the opinion of the author, who believes that if the limitations were appreciated detractors would become satisfied users.

Among oils and resin impregnants, shellac (formed by lac inserts on certain trees in India) has yielded its position to synthetic media, but still remains pre-eminent in certain high voltage applications when low working temperature enables its outstanding electrical properties to be fully exploited. From phenol (carbolic acid) and formaldehyde (wood distillation product) the chemical reaction yields resins which can be dissolved in methylated spirit for coating materials or syrups for binding fillers (such as wood flour) suitable for hot moulding with or without pressure; the considerable differences in behaviour that affect choice for given services make specialist fabrication advisable. Modern practice tends towards the greater use of inorganic materials in built-up form combined with binders.

Of the apparently unending variety of synthetic substances which the chemical industry is producing relatively few examples have had serious attention; some, like artificial rubber, can be made superior to the natural, while treated glass fibre can be utilised under exceptionally severe operating conditions.

Insulation manufacturers are constantly being confronted with demands that indicate the inquirers to be, if not entirely devoid of information, sadly lacking in essential facts. Much is to be gained by revealing details concerning service conditions, and the best interests of the community will be served when insulation engineers are enabled to give service in response to active co-operation on the part of users.

Mining Examinations

AT a meeting on March 8th, at Pontypridd, of the South Wales branch of the ASSOCIATION OF MINING ELECTRICAL ENGINEERS (Mr. C. C. Bleach, branch president, occupying the chair) a talk was given by Principal Robert Janes, of the Treforest School of Mines, on the subject of electrical and mechanical routine examinations in connection with the Association's certificates.

Mr. Janes said that it must be realised that with the increasing electrification and mechanisation of mines a natural aptitude for engineering was not sufficient. It must be reinforced by the possession of knowledge of mechanical and electrical science. There was a great deal of evidence, not only in South Wales, but in the reports of Royal Commissions that the leaders of industry were realising the importance of bringing into the industry young men of good educational standard and not only bringing them in, but keeping them there by giving them full opportunity for taking advantage of the educational facilities available. South Wales employers had been in advance of those in other parts of the country in the matter of releasing their young men on one day per week for attendance at technical classes and that idea was spreading to other parts of the country. South Wales could lay claim to having started the system, which had the full support of the coalowners.

He stressed the importance of the engineer possessing a sound knowledge of English. He also said the student must do the spade work in order to get the full benefit of his training.

Forthcoming Events

A "war-time lunch" has been arranged by the South Midland Centre of the Institution of Electrical Engineers for Saturday, March 29th, at the Grand Hotel, Birmingham. The President of the Institution, Mr. J. R. Beard, will give an informal address. Tickets, price 4s. 6d. each, are obtainable from the hon. secretary, Mr. R. H. Rawll, 65, New Street, Birmingham.

The North-Western Students' Section of the Institution of Electrical Engineers is holding a "Problems Evening" on Tuesday evening, March 25th, at the Engineers' Club, Manchester. The Section's annual dance this year will be a "tea-dance" at the Trafford Public Hall, Talbot Road, Old Trafford, on March 29th. Tickets, 5s. single or 9s. 6d. double, are obtainable from the hon. secretary, Mr. C. B. Simpson, or any member of the committee.

The Aldred Lecture on "Discovery and Invention" is to be delivered at the Royal Society of Arts on March 26th (4.45 p.m.), by Sir Richard Gregory, Bt., F.R.S. Sir Edward Appleton, Secretary, Department of Scientific and Industrial Research, will preside.

Electricity for Nurseries

What is a Fair Basis of Charge?

By G. W. Smeed
B.Sc. (Eng.), A.M.I.E.E.

FOR any continuous commercial transaction to be satisfactory it must be profitable to both the vendor and the buyer. It follows, therefore, that for the most economic transaction to be made the buyer must endeavour to comply with the requirements of the vendor, but the onus is mainly upon the latter to supply the wants of the former. Consequently, to determine a satisfactory rate or rates for electricity supply to any consumer it is necessary to first ascertain the nature of the loads which may be involved, the incidence of the load and the anticipated use, whether the load be power, lighting, heating or cooking. In the particular case of the commercial nursery all these uses of electrical energy are to be met with, although the majority of the load connected is likely to be for power purposes.

The uses to which the electric motor is put in a nursery may be divided into four classes :—(*a*) Pumps for water supplies ; (*b*) stokers for boiler fuelling ; (*c*) pumps for circulating water round the heating pipes ; and (*d*) auxiliary plant such as grading machinery, box-making machines, spraying plant and the like.

Supply to water-pumping units is normally required for two or three hours a day except in very hot weather. For convenience, water pumping is carried out during the mornings when the watering is done and thus a time-switched supply with evening restriction is eminently satisfactory. However, since very little watering is required during the winter, and that only during the morning, the inclusion of a time-switch and perhaps its rental too, makes a somewhat invidious situation. The motors for this work vary in size considerably, depending upon the quantity of water required and its depth, and they range from 3 HP or so to 60-70 HP.

After examining the nature of the load provided by the typical commercial nursery, the author comes to the conclusion that maximum demand should be ignored and that, generally, any restrictions upon use are unnecessary. He favours a block tariff with a comparatively high initial charge

Stoking plant is usually automatically controlled by means of thermostats and is generally in operation for 15 minutes or so per hour during the day, although this period lengthens during the colder hours of the night. For these motors it is essential that supply be continuous in order that the boilers shall be maintained at the desired working temperature and thus ensure an even temperature inside the greenhouses. The same condition applies to pumps for circulating the hot water from the boiler, although in this case continuous supply is not essential but rather desirable. The restriction of the supply naturally impairs the efficient use of circulating pumps, since these are thermostatically controlled and the peak periods are, in general, those when the most rapid temperature changes occur, *e.g.*, when the plant's use is most required. This latter use if supplied under restricted conditions would probably be better should the restriction be the morning.

Owing to the comparatively small use of grading machinery and the other auxiliary plant it is immaterial whether the supply be restricted or not, the primary consideration being cheapness of installation. On this score, however, should the supply be given on a "demand" tariff, care has to be taken not to unnecessarily affect the maximum demand adversely. This might easily occur in cases of small installations or small nurseries where the advantages of electrical plant might be more apparent.

Occasional Uses

With the possible exception of lighting for propagation purposes, the long-hour use of lighting is very unlikely, the supply being required for occasional use in packing sheds and offices or at nights in stokeholds, giving in the main an off-peak load. Heating installations in commercial greenhouse premises are usually confined to office heating and, very rarely, to a small water heater in the main water tank for the dual purpose of preventing freezing and of taking the chill off when watering. The use of electricity for directly or indirectly heating, *e.g.*, soil heating, greenhouses is not in common use except in small installations, due to the comparatively high capital expenditure, nor has electrical soil sterilisation shown much progress to date. An increase in the use of these high-consumption and highly-satisfactory loads would probably occur should a sufficiently attractive rate be available. Soil sterilisation can necessarily only be carried out when the houses are otherwise not in use and the restricted rate of either morning or evening peak would be satisfactory.

The seasonal nature of the existing nursery loads becomes apparent from the periods when the houses are in use and it will be perceived that considerably less use is likely to be made of the supply from October to March, despite the noteworthy exceptions due to the production of flowers for the winter season. The veracity of this is borne out by an inspection of the consumptions of nursery installations. Thus, the effect of individual demands is negligible, occurring as they do during the off-peak season. It follows, therefore, that to afford supply to these consumers on a demand rate, as for ordinary power consumers, would not be satisfactory from the consumers' point of view. Indeed, the consumptions recorded during the winter months are such that with the exception of the winter flower growers it is obvious that they are but the tail end and beginning of the period of use of the supply, and under a demand tariff, these units are likely to appear excessively dear. There is an increasing tendency, where demand tariffs prevail, to preclude the use of electricity by opening the main switch after the autumn meter reading has been taken. This situation, in addition to reducing the sale of energy not likely to affect the maximum demand, tends to jeopardise the chance of connection of additional apparatus as well as restricting the use of that already installed.

A further difficulty arising out of demand tariffs occurs in the accurate measurement of the demands due to the seasonal variations in the load which, of course, form its greatest asset ; this is particularly so if the thermal demand type of instrument is used, which, working as it does on current only, is particularly susceptible to voltage variations. This difficulty is increased by the desirability of maintaining supply during the periods when maintenance or repair work is being carried out, frequently at the expense of the declared voltage. Failure to maintain supply under these conditions will necessarily result in reduced use of the supply and, more important, in dissatisfaction with it. These technical difficulties in the use of the thermal demand indicator are such that it has been found in practice that this otherwise extremely satisfactory and cheap instrument is regarded by nursery consumers as being inaccurate and unreliable.

Incidence of Maximum Demand

With regard to the actual maximum demand of nursery requirements, excluding water pumping which can be restricted if required, its incidence is far more likely to occur at night, since the plant operation is thermostatically controlled. It is thus possible for an installation to record the sum of its demands as its maximum demand, but to create a very much smaller effect on the "peak" load, be it morning or evening.

The tariff for nurseries, covering the whole or unrestricted power supplies only, should therefore be independent of maximum demand. With regard to restricted supplies, these are generally only adopted where the restriction has no effect, *e.g.*, water pumping, so that the supply might well be unrestricted except in the case of the larger motors. Supplies for lighting, heating and the auxiliary power requirements too, might well be given under the one rate, thereby reducing the capital expenditure in wiring the comparatively large runs involved. Such a tariff should therefore be of the block type with a comparatively high unit charge for the first block to allow for the "nuisance" value of the winter quarters' accounts.

By means of such a rate considerable savings might be effected in meters, meter reading, connections and accounts over the existing arrangements involving separate rates and meters.

COMMERCIAL and INDUSTRIAL NEWS

Electricians' Wage Increases. Companies' Reports Held Up

Industrial Registration

FURTHER steps to secure, or redirect, man and woman power were announced this week by the Minister of Labour and National Service. Mr. Bevin said that the Schedule of Reserved Occupations was being considerably revised and that men between the ages of 41 and 45 and women of the ages of 20 and 21 would be required to register for the purposes of industrial service. The first registration under the new proposals would take place on April 5th, and would concern men aged 40 and 41 who were not employed in certain industries. Women of the age of 20 would register on April 19th, and the "twenty-ones" shortly after that date.

Electricians' Wages

As from the commencement of the first full pay period following February 13th, the war bonus granted by the National Joint Industrial Council for the Electricity Supply Industry was raised from 1¾d. to 2¼d. per hour. The new rate is to remain in force until July 1st.

In accordance with the terms of an agreement entered into between the Electrical Contractors' Association of Scotland and the Electrical Trades Union to regulate the wages of electricians on a cost of living sliding scale agreement, an increase of ¾d. per hour is being paid as from March 1st. The new rate will be 1s. 10¼d. per hour. The next review will be in May and a further adjustment will take place in June. The increase in journeymen's wages, besides affecting the electrical contracting industry, also concerns electricians employed in the maintenance of electrical equipment in all classes of factories and workshops, and a large number of men employed by local authorities.

Electricity in Potato Bars

The Ministry of Food's latest scheme for encouraging the greater use of potatoes by the establishment of potato bars, operated privately in the same way as milk bars, opens up a new field for the application of electric cooking apparatus. A collection of attractive recipes for dishes with potatoes as the principal ingredients has been prepared by the Ministry and model bars have already been demonstrated in London with considerable success. In the first of these bars which was set up at Messrs. Bentalls at Kingston-on-Thames, all the equipment used was electric and comprised five domestic type electric cookers, a wash boiler and two electric kettles. The Kingston Electricity Department co-operated in lending the apparatus, the total load of which amounted to approximately 30 kW. At further demonstrations given at the Ministry of Food offices a special feature was made of waffles made partly from potatoes, an electric waffle iron being used for the purpose. Apart from the question of efficiency and cleanliness electrical equipment has indisputable claims for this class of duty on the score of rapid installation. Several caterers have already prepared schemes for opening bars in the Provinces.

The first all-electric potato bar at Messrs. Bentalls, Kingston-on-Thames

An Inquiry from Eire

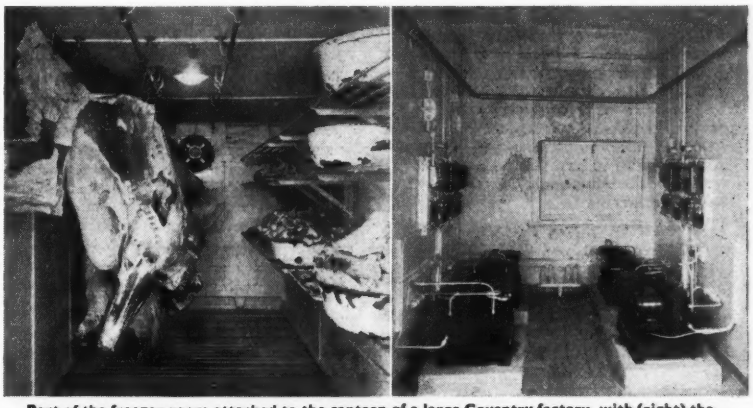
Well-known distributors in Eire are anxious to place substantial orders in this country for electric kettles and toasters. We shall be pleased to pass on letters from any firms interested.

Peruvian Electrical Imports

During the September quarter of 1940 the value of electrical apparatus imported into Peru was 3,353,000 soles as compared with 2,227,000 soles during the corresponding period of 1939. (At par 17.38 soles = £1 sterling).

Safeguarding Food in Industrial Canteens

Many manufacturers and industrialists have given a good deal of consideration to the problem of food storage to meet possible emergencies. In the case of a works canteen this calls for refrigeration on a large scale, and some idea of the amount of emergency food to be stored will be gathered from the fact that at one large works at Coventry the capacity of the works canteen is about 3,000 meals per sitting.



Part of the freezer room attached to the canteen of a large Coventry factory, with (right) the automatic refrigeration equipment

The installation comprises four departments with separate automatic refrigeration control. These are known as the freezer room, the chiller room, the provision room and the cellar, their total capacity amounting to 4,000 cu. ft. The freezer room, of 560 cu. ft., accommodates frozen meat and, by means of a condensing unit rated at 1 HP, its temperature can be confined to between 28 and 30 deg. F. for long periods. The chiller room (840 cu. ft.), which is maintained at a temperature of 34/36 deg. F., serves for the storage of chilled meats for immediate use in the canteen kitchens. The provision room (600 cu. ft.) is set aside for stocks of foodstuffs that need to be preserved at a definite temperature to ensure the retention of their freshness and nutritive values, such as butter, milk, ham, salads, etc. The temperature is kept between 40 and 44 deg. F. The cellar, in which tinned goods, vegetables, fruit and cereals are stocked, has a capacity totalling 2,000 cu. ft. and its temperature is restricted to 44 to 48 deg. F.

The four rooms comprising the installation were specially constructed to ensure against air leakage. They are equipped with fans for internal air circulation, and with bulkhead lighting fittings, in addition to the refrigeration units, which were supplied by Coldair, Ltd. Each of the units is of the standard twin-cylinder condensing type, three being of 1 HP each and the fourth of ¾ HP.

Utility Companies' Reports

In the House of Commons on March 13th, Mr. H. G. Strauss asked the Minister of Information whether the Government's attention had been drawn to the possibility of information of value to the enemy being disclosed in the reports of public utility companies. Mr. Duff Cooper said that the matter had been under consideration by the Government Departments concerned and, pending a decision, it was hoped that these companies would postpone the publication of accounts and the holding of meetings.

Mr. Garro Jones asked whether the position of newspapers and technical papers would be considered, i.e., whether it was fair to put them in the position of having to voluntarily censor matter which might deprive them of revenue. Mr. Duff Cooper

said that the voluntary censorship had worked very satisfactorily and he would deplore any departure from the voluntary principle.

Sir Irving Albery suggested that there was no need for the postponement of the publication of accounts or the holding of meetings if nothing of value to the enemy was disclosed. Mr. Duff Cooper said that they were trying to guard against the disclosure of such information. If accounts were published and meetings held before the matter had been properly gone into such information might unwittingly be given to the enemy.

Ban on Aluminium-ware Exports

Under a Board of Trade Order signed on March 12th, the export of aluminium hollow-ware will be prohibited after March 26th. The Ministry of Aircraft Production will purchase at cost stocks held by persons registered under the Limitation of Supplies (Miscellaneous) Orders. Applications should be made to the Aluminium Control, Southam Road, Banbury.

G.E.C. Ambulance for Birmingham Hospitals

The directors and employees of the General Electric Co., Ltd., Witton, through their benevolent funds (Engineering and Carbon Works) recently presented a four-stretcher ambulance to Col. Sir Bertram Ford, representing the Birmingham Hospitals Contributory Association. Mr. J. H. Hayden, hon. sec. of the benevolent funds, mentioned that the gift of an ambulance was the fulfilment of a promise to Col. Sir Bertram Ford which had been delayed owing to the War. Mrs. Railing, wife of Dr. A. H. Railing, formally made the presentation.

Sir Bertram Ford, in response, expressed his thanks and appreciation of the gift. Dr. Railing paid a tribute to Sir Bertram and voiced the thanks of the company for the opportunity afforded both directors and employees to help him in the way they had done.

Those present at the ceremony, in addition to those mentioned above, were Mr. T. W. Place, secretary of the Hospitals Contributory Association, Councillor Dalton, chairman of the Ambulance Committee, Mr. H. C. Aston, secretary of the Birmingham Saturday Hospitals Fund, Dr. C. C. Garrard, Dr. Kahn, and Messrs. J. L. Morris, J. J. Gracie, W. H. Heaton and Goldsmith.

Cable Accessories Production

Since we described the production methods of the associated companies, the Bowthorpe Electric Co., Ltd., and the Hellermann Electric, Ltd., in our issue of February 9th, 1940, many developments have taken place affecting the whole range of products. First of all, as business had so expanded that the factory at Croydon was quite inadequate, Mr. J. Bowthorpe, the managing director decided a few months ago to transfer production out of London to a works in the provinces having four times the accommodation (10,000 sq. ft.) and additions to the works are already planned.

A selection of cable accessories now made by the Bowthorpe Electric Co., Ltd.

With the move to the new factory an important step forward in production has been made possible. Till then many of the components used in the company's products, sometimes even the complete products, had been purchased from other manufacturers, and actually before the war the company was dependent for certain patented articles or supplies from Germany. Now the factory is practically self-contained.

This home production has resulted in several modifications and improvements in the design of apparatus. The Hellermann tool for use with rubber sleeves for binding and insulating conductors has, for instance, been fitted with a new type of spring and has been redesigned to prevent straining of the lower spring: the centre boss, too, has been strengthened and the bush improved. Two other recent developments in connection with the sleeves are that they are now obtainable coloured (in nine different hues) and marked for identification purposes. With the difficulty of obtaining coloured cables the colour feature is particularly useful at present.

Over half of the products of the Bowthorpe Electric Co., Ltd., which is concerned with the manufacture of "Goodtric" line fittings, including cone type tension joints for copper conductors from 0.025 sq. in. to 0.1 sq. in., line taps, line clamps, P.G. clamps, etc., are now destined for export, the company having felt the benefit of the elimination of German trade in such articles, especially in South Africa and South America. Mr. Bowthorpe tells us that a recent order just completed for the Palestine Electric Corporation, Ltd., comprised 40,000 line clamps. There are also expectations of a considerable growth in the home demand.

Automobile Lamps

There will be issued shortly, at the request of the Ministry of Aircraft Production, a specification (B.S.S. 941) for 6 and 12 V bulbs for head, side and rear lamps of motor cars and the motor car class of goods vehicle, but not intended to cover lamps for public service vehicles or for heavy commercial goods vehicles.

Copies may be had from the British Standards Institution, 28, Victoria Street, London, S.W.1., price 2s. 3d., post free.

Liquidator's Application

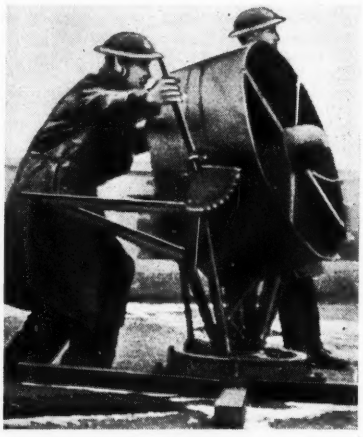
In the Chancery Division on March 10th Mr. Justice Simonds delivered judgment in an application by the liquidator of the Great Eastern Electric Co., Ltd., Mr. Houston, for the direction of the Court in the circumstances raised.

His Lordship said that in March, 1938, the directors of the company made a declaration of solvency and a few days afterwards it was decided to liquidate the company by way of a members' voluntary winding-up. Mr. Houston, who was a director, resigned from the board and was appointed liquidator. He carried on the business and paid 10s. in the £ to creditors for about £6,000; certain small creditors had not been paid.

Mr. Houston asserted that after looking into the position he considered that it was possible to pay 20s. in the £ if the assets were properly realised. His Lordship said that Mr. Houston's good faith was not impugned, but he did not realise the dangers, having regard to the course of events. On the whole, his Lordship came to the conclusion that Mr. Houston had properly exercised his statutory right to carry on the business for the benefit of the company. It followed from what he had said that the post-liquidation creditors must be paid before further payments were made to any pre-liquidation creditors. Mr. Houston was entitled to his remuneration and costs.

"Roof Spotting" Aid

An aid to "roof spotting" which is being used at the works of Benjamin Electric, Ltd., consists simply of a 3-ft. parabolic reflector, at the focal point of which a sensitive microphone is suspended from rubber bands (inverted, facing inward towards the reflector). An associated four-valve amplifier in a box attached to the reflector framework is matched with the "mike" and one or more pairs of headphones, the latter being of the low-resistance kind to withstand rough usage. The operator has merely to swivel the reflector round horizontally and tilt it vertically until the sound of an aeroplane is heard at its greatest volume. Then by listening carefully he is able to judge whether the aircraft is approaching (growing volume) or travelling away (decreasing sound) from the observer. In this way it is possible to avoid giving the "take cover" signal unnecessarily, so saving working time in the factory.



Combined reflector and microphone for roof spotting at the Benjamin works

Changes of Address

Mr. R. B. Whittick, agent for G. P. Dennis, Ltd., G. H. Carter & Sons, Heatovent Electric Ltd., and the Metropolitan Electric Cable and Construction Co., Ltd., has removed to 66, Victoria Street, London, S.W.1 (telephone: Victoria 6565).

Fitzroy Radio, Ltd., announces that it has removed to 105-9, Judd Street, London, W.C.1. Mr. G. Mayle is now no longer connected with the company. Any outstanding liabilities of Fitzroy Radio will be settled upon application being made to the company.

TRADE MARK APPLICATIONS

AMONG recent applications received for British trade marks are the following, objections to which may be entered within a month of March 12th:—

Aerolux.—No. 613,253, Class 1 (IV). Fluxes for electric welding.—Metropolitan-Vickers Electrical Co., Ltd., Number One, Kingsway, London, W.C. 2.

Eterno-lite.—No. B611,644, Class 11 (IV). Electric lamps, lamp bulbs, torches and portable lighting units.—Joseph Capo-Bianco, 62 Viceroy Court, Prince Albert Road, London, N.W.8.

ELECTRICITY SUPPLY

Distribution Plant at Southport. Change-over at Workington

Bangor. — DEARER ELECTRICITY. — Increased electricity charges are to be introduced next month. The lighting flat rate will be 7d. per kWh, the increase to consumers being from 3d. to 6d. per week.

Blackpool.—SHELTER LIGHTING.—The Corporation Emergency Committee has approved a scheme by the electrical engineer for lighting 302 shelters.

Burton-on-Trent. — RURAL SUPPLIES.—The Corporation Electricity Committee is to provide supply to farms and cottages at Lullington at a cost of £799.

Cardiff.—MAINS EXTENSION.—The Corporation Electricity Committee is to extend mains at a cost of £1,643.

Carlisle.—HIRE AND HIRE-PURCHASE SCHEMES.—The Corporation Electricity Committee is seeking sanction to borrow £5,000 out of balances on hire and hire-purchase schemes.

Chesterfield.—INCREASED BULK SUPPLY.—In order to meet increased demands for electricity the borough electrical engineer has given the Derbyshire and Nottinghamshire Electric Power Co. notice of the Corporation's desire to increase the authorised maximum demand from 5,000 to 7,000 kW.

RELIEF OF RATES.—The Corporation Electricity Committee has decided to allocate £3,000 towards the relief of the rates for the year ending March 31st, 1942.

Essex. — ELECTRICITY FOR WARDENS' POSTS.—The County Council Emergency Committee is to install electricity in wardens' posts at a cost of £259.

Grimsby. — DEARER ELECTRICITY. — A further increase of 5 per cent. decided upon by the Corporation Electricity Committee will become operative as from the first meter reading after March 31st next.

Harrow.—HEATING OF SHELTERS.—The heating by electricity of basement shelters at Herga and Granada car park trenches has been approved by the Urban District Council.

Keighley. — LIGHTING SCHEMES. — The Town Council is to have an emergency lighting set installed for the municipal rooms and hall, and to wire for electricity Stanbury, Haworth, and Horkinstone Schools, Oxenhope.

London.—BETHNAL GREEN.—The annual report of the electricity undertaking (engineer: Mr. E. E. Jolly) for the year ended March 31st, 1940, shows a total revenue of £138,880 as compared with £142,587 for 1938-39. Working expenses rose from £97,487 to £103,825, and after meeting loan charges, etc., there is a net deficit for the year of £988, as compared with a net profit of £11,993 for the previous year. There was a slight decrease in the kWh sold, from 21,098,175 to 20,960,686.

Maidenhead.—LOANS.—Application is being made by the Town Council for sanction to borrow £1,500 for transformers and substation equipment, and £1,500 for mains and services.

Milford Haven. — CHANGE-OVER. — The Urban District Council is applying for sanction to borrow £5,242 for the North Road and Precelly Place change-over.

Plymouth.—SUPPLIES TO UNINHABITABLE PREMISES.—With regard to outstanding accounts for the supply of electricity to premises rendered uninhabitable by enemy action, the Corporation Electricity Committee has decided to remit amounts under 5s.

Scarborough.—LOANS SANCTIONED.—The Corporation Electricity Committee has obtained sanction to borrow £1,589 for mains and services, £500 for substations and £400 for meters.

Southport.—NEW PLANT.—In consequence of the heavy load on certain of the cable networks, the Corporation Electricity Committee is to purchase pillars, 100-kVA transformers, etc., at a cost of £6,500. Switchgear at substations is to be replaced at a cost of £3,600.

Stalybridge.—SHELTER INSTALLATIONS.—A scheme for lighting and heating shelters is to be prepared by the Corporation Emergency Committee.

Stretford.—LOAN.—The Corporation is to lend £41,885 to the Stretford and District Electricity Board for mains, services, change-over, substations and plant.

Sunderland.—COAL CLAUSE EXTENDED.—The Electricity Committee has decided that the "Standard Coal Clause," which has hitherto been applied only to tariffs for power, traction and heating purposes, shall in future apply to all other electricity tariffs.

Tyldesley. — SHELTER LIGHTING. — The Urban District Council is having a scheme prepared for installing electric lighting in communal and public shelters.

Wakefield.—KIOSK SUBSTATION.—The Corporation Electricity Committee is to purchase a steel kiosk at a cost of about £340 for use as a temporary substation.

Walsall.—SUPPLY GUARANTEES.—The Corporation Finance Committee has considered the question of sureties for the supply of electricity and considers that it is inequitable for a surety to be called upon to implement a guarantee after a long period has passed during which regular payments have been made by the consumer. The form of guarantee has accordingly been amended to provide for the guarantee covering only payments falling due within three years from the date of the agreement except in special cases.

Wardle.—SHELTER LIGHTING.—Electric lighting is to be installed in public shelters.

Workington.—CHANGE-OVER SCHEME.—The Corporation Electricity Committee is seeking sanction to borrow £8,640 for the completion of the change-over to 11,000 V before the end of the year. Sanction has been obtained to borrow £2,443 for supplying the Salterbeck housing estate.

Overseas

Argentina.—SUPPLY DEVELOPMENTS.—In a recent issue of the *Revista Electrotecnica*, the official organ of the Argentine Association of Electrical Engineers, a summary is given of the position of the electric power supply industry in the Argentine Republic at the end of 1938, based on figures drawn up by the Government Statistical Department. It shows that while, as compared with 1937, the number of power stations in the country has increased from 915 to 937, the aggregate capacity of the generating plant has declined from 1,299,256 kVA to 1,283,255 kVA, of which all but 141,139 kVA is generating AC. The aggregate output of electric power in Argentina during 1938 is given as 2,331.2 million kWh, as compared with 2,203.1 million kWh in the preceding year, an advance of 5.8 per cent. Of the production 32.1 per cent. was used for interior lighting, 6.9 per cent. for street lighting, 43.1 per cent. for power purposes, 17.6 per cent. for railway and tram traction and 0.3 per cent. for free official purposes.

Canada.—OPPOSITION TO ST. LAWRENCE SCHEME.—Opposition to the proposed $600,000,000 St. Lawrence waterways power and navigation development which he characterised as "national suicide" and leading to annexation to the United States, was voiced recently in the Quebec Legislature by a former Premier Mr. Duplessis, leader of the Opposition. The proposed canalisation was not a Canadian project, he said, was of no interest or advantage to Canadians,and would constitute unjustifiable expenses.

HYDRO-ELECTRIC SCHEME.—North-West Territories water has been harnessed to supply power for mines at the northern settlement of Yellowknife, the first hydro-electric power project in the Territories, states a Mines and Resources Department announcement. Three mines receive power from the plant, situated eighteen miles north of Yellowknife, and domestic requirements of the settlement will be supplied, while three other mines will be supplied soon. Equipment was hauled to Yellowknife over 530 miles of ice and snow along the Grimshaw —Great Slave road and over the lake last year. The road was prepared for tractor service by clearing bush and filling in deep cuts. A hundred tons of equipment and supplies were hauled last winter. The cost of the plant was estimated at $600,000, and the work included the construction of a dam 760 ft. long and 16 ft. high, a rock tunnel 800 ft. long, and a 33,000-V steel tower transmission line.

TRANSPORT

Chesterfield.—RELIEF OF RATES.—The Corporation Transport Committee is to allocate £1,000 for the relief of the rates for the year ending March 31st, 1942.

Wolverhampton. — CONTRIBUTION TO RATES.—A sum of £10,000 is to be transferred from the profits of the transport undertaking in aid of the rates for the year ending March 31st, 1942

RADIO AND TELEPHONY

Afghanistan.—NEW RADIO STATION.—An *Exchange Telegraph* message states that, according to the Berlin radio, German experts have finished constructing a wireless station at Kabul.

China.—TELECOMMUNICATION DEVELOPMENTS.—According to *Foreign Communication News*, the Chinese Government has drawn up a seven years' plan of telecommunication developments in Northern China and Inner Mongolia. It is feared, however, that the work will be delayed owing to the heavy cost and the difficulty of obtaining material supplies in these difficult times. Telephonic communication has been established between Kalgan and various places in Japan and also between certain towns in Mongolia and Peiping and Tientsin. A radio-telephonic service is also now said to be in operation between Shanghai and Osaka, Japan.

Denmark.—TELEPHONE AND TELEGRAPH DEVELOPMENT.—According to the annual report for 1939–40 of the Danish Department of Posts and Telegraphs, there were 6,465 miles of telegraph wires and 122,221 miles of telephone wires in use in Denmark at the end of that period.

NEW PATENTS

Electrical Specifications Recently Published

The numbers under which the specifications will be printed and abridged are given in parentheses. Copies of any specification (1s. each) can be obtained from the Patent Office, 25, Southampton Buildings, London, W.C.2.

1939

14622. "Electric insulators." K. N. Gerow. May 16th, 1939. (533771.)

17033. "Indicating means for radio landing system." Intercontinental Service Corporation. October 26th, 1938. (533705.)

17982. "Circuits including electric discharge devices." British Thomson-Houston Co., Ltd., and W. J. Scott. June 20th, 1939. (533843.)

19446. "Electric batteries." Burndept, Ltd., and R. P. Richardson. July 4th, 1939. (Cognate application, 22680/39.) (533773.)

20350. "Time delay circuits for use in connection with electric discharge tubes." Marconi's Wireless Telegraph Co., Ltd., and R. H. Burdick. July 12th, 1939. (533635.)

20739. "Contact-breaker mechanisms for electrical ignition apparatus." British Thomson-Houston Co., Ltd., and R. T. Coe. July 17th, 1939. (533776.)

20783. "Electric discharge devices." J. Fodor. July 17th, 1939. (533636.)

22951. "Electrically heated vaporising device for disinfecting and sterilising purposes." D. E. Aslen. August 9th, 1939. (533637.)

23686. "Directional radio receivers." Marconi's Wireless Telegraph Co., Ltd. September 23rd, 1938. (533782.)

23785. "Cathode-ray tube and like apparatus, and methods of operating the same." Baird Television, Ltd., and C. S. Szegho. August 17th, 1939. (533650.)

23825. "Back coupled electron discharge tube amplifiers." Marconi's Wireless Telegraph Co., Ltd., and O. E. Keall. August 18th, 1939. (533784.)

23835. "Electrical supply installations for the lighting of railway and other vehicles." J. Stone & Co., Ltd., and L. R. Nixon. August 18th, 1939. (533716.)

23855. "Loud speaking telephone receivers." Goodmans Industries, Ltd., G. A. Barden, and E. S. Newland. August 18th, 1939. (533913.)

23876. "Insulated conductors." British Thomson-Houston Co., Ltd. August 20th, 1938. (533786.)

23882. "Aerial coupling circuits." Standard Telephones & Cables, Ltd., W. A. Beatty, and P. K. Chatterjea. August 18th, 1939. (533717.)

24643. "Electric connectors or couplings." Simplex Electric Co., Ltd., and P. W. Davis. August 28th, 1939. (533923.)

24709. "Weaving machinery." British Thomson-Houston Co., Ltd. August 27th, 1938. (533924.)

24785. "Piezo-electric relays." Standard Telephones & Cables, Ltd. Spetember 9th, 1938. (533925.)

25344. "Electric plug and socket connectors." E. S. Conradi. September 7th, 1939. (Addition to 490406.) (533723.)

27833. "Hot cathode rectifiers filled with mercury vapour." M-O Valve Co., Ltd., and H. T. Ramsay. October 13th, 1939. (533934.)

28739. "Lighting fittings." General Electric Co., Ltd., and S. S. Beggs. October 26th, 1939. (533938.)

29175. "High frequency electric apparatus." British Thomson-Houston Co., Ltd. November 1st, 1938. (533939.)

29817. "Electrical synchronising arrangements for controlling the coupling together of rotatable members." General Electric Co., Ltd., E. H. Croft and H. Randall. November 10th, 1939. (533670.)

29973. "Magnetox." Hasler Akt-Ges. Werke für Telephonie und Prazisionsmechanik. October 7th, 1939. (533675.)

29983. "Electrical relays." C. Ryder and Metropolitan-Vickers Electrical Co., Ltd. Novemeber 13th, 1939. (533679.)

29985. "Resonant circuits." British Thomson-Houston Co., Ltd. November 12th, 1938. (533680.)

29988. "Multiple electric coupling devices." G. Maag. March 4th, 1939. (533681.)

29989. "Low frequency amplifiers." Philips Lamps, Ltd. November 15th, 1938. (533682.)

30071. "Method of constructing stratified electrode systems." Naamlooze Vennootschap Philips' Gloeilampenfabrieken. November 17th, 1938. (Addition to 510141.) (533686.)

30097. "Electric flashlamps." British Thomson-Houston Co., Ltd. November 16th, 1938. (533688.)

30110. "Electric circuit interrupters." General Motors Corporation. November 19th, 1938. (533690.)

30111. "Electric circuit interrupters." General Motors Corporation. November 19th, 1938. (533691.)

30139. "Electric furnaces of the induction type." P. Fustier and J. Bocuze & Cie Soc. Anon. May 1st, 1939. (533695.)

30140. "Electrically driven pumping apparatus for liquids." Partridge, Wilson & Co., Ltd., and H. G. A. R. Wilson. November 15th, 1939. (533696.)

30141. "Method of and device for reproducing cross-sections of bodies by means of X-rays." Philips Lamps, Ltd. November 18th, 1938. (Addition to 530477.) (533697.)

30161. "Vacuum cleaners." Electrolux, Ltd. December 8th, 1938. (533701.)

30214. "Electric eddy current dynamometers, clutches and couplings." M. P. Winther. November 16th, 1939. (533725.)

30218. "X-ray apparatus." Machlett Laboratories, Inc. November 17th, 1938. (533727.)

30276. "Supporting means for piezo-electric plates." Standard Telephones & Cables, Ltd. December 30th, 1938. (533731.)

30278. "Electron discharge devices employing secondary electron emission." Standard Telephones & Cables, Ltd. (Matériel Téléphonique Soc. Anon.). November 17th, 1939. (533732.)

30329. "Stabilised vacuum tube oscillators." Standard Telephones & Cables, Ltd December 20th, 1938. (Addition to 510379.) (533736.)

30337. "Moving elements of electrical measuring instruments of the moving coil type." Evershed & Vignoles, Ltd., and C. Midworth. November 18th, 1939. (533737.)

30345. "Electric torches or flash lights." H. W. Chun. November 18th, 1939. (533738.)

30417. "Electric fire lighting apparatus." W. Lorch and Elga Products, Ltd. November 20th, 1939. (533742.)

30420. "Dynamo-electric machines." Ercole Marelli & Cia Soc. Anon. August 3rd, 1939. (533743.)

30471. "Electric furnaces of the induction type." Electric Furnaces Co., Ltd., and J. C. Howard. November 21st, 1939. (533747.)

30472. "Multiple contact banks of the type used on selector switches in telephone systems." General Electric Co., Ltd., and W. R. Rose. November 21st, 1939. (533748.)

30473. "Holders for piezo-electric crystals." General Electric Co., Ltd., F. Clark and A. E. Hearne. November 21st, 1939. (533946.)

30494. "Conveyors for newspapers or the like." Igranic Electric Co., Ltd., and H. H. Rapley. November 21st, 1939. (533750.)

30557. "Electric motor control gear." British Thomson-Houston Co., Ltd., and J. S. Hartshorn. November 22nd, 1939. (533947.)

30558. "Surface condensers." British Thomson-Houston Co., Ltd. November 23rd, 1938. (533755.)

30683. "Manufacture of electrically welded metal tubing." F. G. Spurway. November 16th, 1938. (533760.)

30747. "Electromagnets." Maschinenfabrik Oerlikon and A. Schnetzler. November 24th, 1939. (533765.)

30845. "Welding machines." British Thomson-Houston Co., Ltd.November 25th, 1938. (533798.)

30906. "Welding rod." Philips Lamps, Ltd. November 29th, 1938. (533805.)

30968. "Electron discharge devices." Standard Telephones & Cables, Ltd. November 29th, 1938. (533807.)

30983. "Electric arc furnaces." T. D. Kelly. November 28th, 1939. (533810.)

31013. "Interference suppressors for radio receivers." Marconi's Wireless Telegraph Co., Ltd. November 29th, 1938. (533812.)

31136. "Apparatus for making mounts for electric lamps and the like." British Thomson-Houston Co., Ltd. November 30th, 1938.,(533820.)

31160. "H.p.m.v. electric discharge lamps having sealed outer vitreous jackets and their manufacture." General Electric Co., Ltd., and F. A. Foxon. November 30th, 1939. (533821.)

31166. "Course indicating radio receivers." Philips Lamps, Ltd. December 3rd, 1938. (533822.)

31171. "Cyclotrons." Akt.-Ges. Brown, Boveri & Cie. December 5th, 1938. (533823.)

31222. "Conductor coils for electrical apparatus." British Thomson-Houston Co., Ltd. December 1st, 1938. (533825.)

31223. "Electric discharge devices." British Thomson-Houston Co., Ltd. December 1st, 1938. (Addition to 518015.) (533826.)

31258. "Dynamo-electric machines." English Electric Co., Ltd., L. Roberts and R. D. Ball. December 1st, 1939. (533829.)

31269. "Electric welding machines." British Thomson-Houston Co., Ltd. December 1st, 1938. (533830.)

31395. "Electric air-break circuit interrupters." British Thomson-Houston Co., Ltd. December 2nd, 1938. (533834.)

31422. "Coating of bodies with glass or other fusible mineral substance." British Thomson-Houston Co., Ltd. (Tokyo Electric Co., Ltd.). December 4th, 1939. (533835.)

31423. "Pressure responsive devices." British Thomson - Houston Co., Ltd. December 3rd, 1938. (533836.)

31541. "Overload time limit relay." Maschinenfabrik Oerlikon. December 13th, 1938. (533861.)

31548. "Mica-dielectric condensers." Philips Lamps, Ltd. December 8th, 1938. (533862.)

31603. "Controllers for alternating current motors." Igranic Electric Co., Ltd., and J. R. Taylor. December 6th, 1939. (533865.)

31615. "Fluid control valve testing arrangements." British Thomson-Houston Co., Ltd. (General Electric Co.). December 6th, 1939. (533866.)

31629. "Cooling system for packings of steam turbines." Svenska Turbinfabriks

(*Concluded on page* 489)

FINANCIAL SECTION

Company News. Liquidations and Bankruptcies. Stock Exchange Activities

Reports and Dividends

The Telegraph Construction & Maintenance Co., Ltd., reports net profits for 1940, after providing £53,552 (against £18,000 for 1939) for taxation, of £47,569, as compared with £62,973 in the previous year. The final dividend for the year is 5 per cent., making 10 per cent. for the year (against 10 per cent. and a capital bonus of 5 per cent). No allocation is made to reserve for contingencies, which a year ago received £25,000. The balance carried forward is £35,189 (against £33,063 brought in).

The annual meeting of the company was held on Tuesday last, but a statement by Mr. C. F. Campbell (chairman), was circulated to shareholders in advance. In this Mr. Campbell states that during 1940 the company's factories were engaged to a large extent upon Government work. With the orders in hand, all branches are working to full capacity and recently they have had to arrange for two subsidiary factories in order to meet the requirements of the business. The turnover for the year increased by approximately 20 per cent. This increase is reflected in all departments, except that of power cables, which, for reasons given last year, is necessarily curtailed during the war. The Selborne Estate in Malaya is now in full production and is running on a profitable basis.

Associated Electrical Industries, Ltd.—A preliminary statement just issued shows a profit for 1940 of £1,709,695, an increase of £239,430 as compared with 1939. Depreciation absorbs £261,283 (against £234,956) and taxation £992,900 (£758,226). A further £100,000 is appropriated for dividend equalisation. The ordinary dividend for the year is again 10 per cent. and £265,472 is carried forward (against £253,118 brought in).

The British Thomson-Houston Co., Ltd., in a preliminary statement, shows a profit for 1940 of £1,357,516, as compared with £1,038,046 for the preceding year. Provision for taxation takes £785,000 (against £410,000) depreciation £242,895 (£287,087) and reserve receives £100,000. The dividend for the year on the ordinary shares (held by Associated Electrical Industries, Ltd.), is again 7 per cent., less tax and the carry forward is raised from £122,058 to £196,310.

Enfield Cable Works, Ltd., reports a record net profit of £224,215 for 1940, as compared with £180,603 (before taxation) for 1939. The final ordinary dividend is 6½ per cent. (against 10 per cent.), making 12½ per cent., less tax, for the year (against 16¼ per cent.).

British Insulated Cables, Ltd.—The statement of accounts for 1940 shows that the profits rose from £783,224 in 1939 to £786,232, from which the following deductions have been made :—Depreciation £209,622 ; directors' fees and works committee remuneration £18,333, and war contingencies £100,000. The final ordinary dividend is 10 per cent., which with the 5 per cent. interim plus a cash bonus of 5 per cent., again makes 20 per cent., less tax, for the year. The balance carried forward is £488,690 (against £488,305 brought in).

The Lancashire Dynamo & Crypto, Ltd., has announced a final dividend of 10 per cent. on the ordinary shares, with a bonus of 5 per cent., making 20 per cent. for 1940 (unchanged). The net profit available for distribution is £104,000 (last year same), after charging income-tax and E.P.T.

Taylor, Tunnicliff (Electrical Industries), Ltd., reports a net dividend income from subsidiaries of £28,516 for 1940, as compared with £33,285 for the period November 30th, 1938 (date of incorporation) to December 31st, 1939. As already announced the final ordinary dividend is 10 per cent., again making 12½ per cent. for the year, and the balance carried forward is £624 (against £854 brought in).

Switchgear & Cowans, Ltd., are paying a dividend on the ordinary shares of 15 per cent. actual for 1940 (against 10 per cent. for 1939).

The Hoffman Manufacturing Co., Ltd., proposes to pay a final dividend of 10 per cent., making 17½ per cent., free of tax, for 1940 (unchanged). The net profits for the year are £250,941, as compared with £264,243 for 1939.

The Automatic Telephone and Electric Co., Ltd., reports net profits for 1940 of £238,052, as compared with £276,249 for 1939. The final dividend on the ordinary stock is 7 per cent., and a bonus of 2½ per cent. is paid, again making 12½ per cent. for the year. The dividend on the deferred stock and shares of 10 per cent., and a bonus of 2½ per cent. is also unchanged.

The British Aluminium Co., Ltd., in a preliminary statement, reports a net profit for 1940 of £508,156, as compared with £647,546 for the previous year. Reserve receives £100,000, and the final ordinary dividend is reduced to 7 per cent., making 10 per cent. for the year (against 12½ per cent.). The balance carried forward is £194,796 (against £176,640 brought in).

Charles Clifford & Son, Ltd., report a net profit for 1940 of £23,270, to which is added £21,997 brought in, making £45,267. It is proposed to pay a final ordinary dividend of 1s. per share, making 10 per cent., tax free, for the year, plus a bonus of 1s. 6d. per share, tax free. War contingency reserve receives £10,000 and £22,967 is carried forward.

Hoover, Ltd., report a net profit for 1940 of £290,486, as compared with £248,412 for 1939. The dividend for the year is maintained at 15 per cent., by the final payment of 11¾ per cent.

The National Gas & Oil Engine Co., Ltd., announces a dividend of 5 per cent. for 1940, against 2½ per cent. for the preceding year.

The British Power & Light Corporation, Ltd., reports a profit for 1940 of £263,293, as compared with £251,265 for 1939. After providing £127,500 (against £88,250) for taxes, it is proposed to pay a final ordinary dividend of 4 per cent., making 6 per cent. for the year (against 7 per cent.), and to carry forward £99,111 (against £83,378 brought in).

The Lancashire Electric Light & Power Co., Ltd., reports that the trading profit of the subsidiary companies for 1940, plus interest receivable, was £617,143, as compared with £602,504 for the preceding year which, with £10,867 brought in, makes £628,010. Of this £47,774 is appropriated for income tax, £311,500 for depreciation, £12,000 for reserve for contingencies, and £14,749 is carried forward, leaving a balance of £241,987, which with management fees and sundry receipts amounts to £256,549. After deducting directors' fees, establishment charges and debenture interest, there is a balance of £210,062 (against £234,336), which with £14,792 brought in, makes £224,854. The dividend on the ordinary stock for the year is maintained at 7½ per cent., by a final payment of 5 per cent., less tax, and £15,384 is carried forward. The report states that the increase in the number of consumers and revenue received has continued.

The Metropolitan Electric Supply Co., Ltd., in its report for 1940 shows that the gross revenue increased by £305,591 to £2,071,021, and working expenses rose by £324,809 to £1,625,503. The net revenue, fell therefore, from £464,736 to £445,518, while interest receipts, etc., amounted to £199,973 (against £222,949). After providing for debenture interest, etc., and placing £223,234 to depreciation and reserve accounts, it is proposed to pay a final dividend on the ordinary stock of 5 per cent., making 8 per cent. for the year (against 10 per cent.), and to carry forward £127,653 (against £127,297 brought in).

Clyde Valley Electrical Power Co.—The report for 1940 shows a balance of profit of £610,594, including amount transferred to

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New Patents (*Continued from page 488*)

Aktiebolaget Ljungstrom. February 13th, 1939. (Cognate application, 31630/39.) (533867.)

31672. "Electric air heating apparatus." British Thomson - Houston Co., Ltd. December 9th, 1938. (533869.)

31673. "Electromagnetic relays." British Thomson-Houston Co., Ltd. December 8th, 1938. (533870.)

31722. "Sources of light of which a h.p.m.v. lamp is one element." General Electric Co., Ltd., and J. Cates. December 7th, 1939. (533874.)

31827. "Elastic fluid power plants." British Thomson - Houston Co., Ltd. December 8th, 1938. (533882.)

31828. "Regulating means for elastic fluid turbines." British Thomson-Houston Co., Ltd. (General Electric Co.). December 8th 1939. (533883.)

31896. "Adjustable slidable electrode condensers." Philips Lamps, Ltd. December 12th, 1938. (533887.)

31958. "Temperature regulator." Landis & Gyr Akt.-Ges. January 14th, 1939. (Addition to 475481.) (533890.)

32032. "Hand or portable tools incorporating a built-in electric motor drive." S. Wolf & Co., Ltd., and S. G. Nicholson. December 13th, 1939. (533892.)

32050. "Production of hot gases under pressure by means of a gas turbine." Akt.-Ges. Brown, Boveri & Cie. December 27th, 1938. (533893.)

32062. "Modulated carrier signal translating systems." Hazeltine Corporation. January 10th, 1939. (533894.)

32115. "Mercury circuit interrupters." General Motors Corporation. December 15th, 1938. (533896.)

32142. "Electrodeposition of metals." W. W. Triggs (Harshaw Chemical Co.) December 13th, 1939. (Addition to 528498.) (533901.)

32248. "Screened inductance coils, particularly frame aerials." Philips Lamps, Ltd. December 17th, 1938. (533905.)

32282. "Electric measuring apparatus." British Thomson - Houston Co., Ltd. December 17th, 1938. (533907.)

32299. "Contact for electromagnetically driven fuel delivery pumps." J. J. V. Armstrong (R. Bosch Ges.). December 15th, 1939. (533908.)

contingency fund £250,000 and war damage insurance (£50,000), as compared with £627,901 for 1939. The balance brought forward is £179,214, making £789,808. The dividend on the ordinary stock is maintained at 8 per cent. by a final distribution of 3 per cent. and £179,808 is carried forward. The position of the three subsidiaries, the Lanarkshire Hydro-Electric Power Co., the Strathclyde Electricity Supply Co., and the Clyde Valley Accessories, Ltd., continues to be satisfactory. The death of Messrs. C. Ker and D. Cooper, directors, is recorded, together with the appointment to the board of Mr. T. H. Thorneycroft and Sir Harold E. Yarrow, Bt. Mention is also made of the death of the secretary, Mr. A. Miller.

The Scottish Power Co.—Presiding at the annual meeting on March 14th, Mr. G. Balfour (chairman) said that during the year under review they increased their maximum demand, kWh sold and number of consumers. It was necessary to plan ahead to meet post-war requirements, and the Grampian Co. had made application to Parliament to develop additional water resources. They would urgently require increased plant capacity to enable them to supply the additional demand, including provision for the development in the Highland area in which the new water power was located. All their hydro-electric and steam plants operated satisfactorily through out the year and their services were well maintained. They reduced their domestic charges in the June quarter, 1939, and they had been able to maintain the reduced charge. They now supplied in an area of nearly 13,000 square miles with a population of 1,000,000 and nearly 100,000 consumers were connected.

The Midland Counties Electric Supply Co., Ltd., held its annual meeting on March 12th when Mr. G. Balfour (chairman), said that the electricity supply business had been satisfactory and good progress had been made in all departments, although they had cut out canvassing and their usual business-getting activities. Four years ago they made reductions in the charges to domestic users and notwithstanding heavy increases in costs they had made no increase in charges; indeed, if the outlook was more settled, they would contemplate certain reductions in the tariffs. They were restricting their expenditure to the narrowest possible limits and endeavouring while the war lasted to provide for capital expenditure out of undistributed earnings, resorting to temporary borrowings when necessary.

The Newcastle & District Electric Lighting Co., Ltd., reports a gross profit for 1940 of £69,245, as compared with £69,385 for 1939, which with £14,999 brought in makes £84,244. After deducting debenture interest, depreciation and leasehold redemption, there is a balance of £39,058. The dividend for the year is again 7 per cent., less tax, and £14,908 is carried forward.

The Midland Electric Corporation for Power Distribution has declared a final dividend of 6 per cent., again making 9 per cent. for the year.

The South Metropolitan Electric Supply Co., Ltd., is paying a final dividend of 2 per cent. (against £5 13s. 1d. per cent.), making 5 per cent. for 1940 (against £8 13s. 1d. per cent.).

The Mersey Railway Co.—Presiding at the annual meeting held on March 11th, Mr. J. Waddell (chairman), said that the volume of traffic carried during the past year had been satisfactory, but it was not possible to give any figures as Railway Clearing House returns regarding through traffic from other companies' lines were not now available. In view of the increased working costs which war conditions had imposed, they had, in common with other controlled railways, increased their fares during the year by 10 per cent. on May 1st, and by a further 6⅔ per cent. on December 1st.

Northampton Electric Light and Power Co., Ltd.—Presiding at the annual meeting on March 13th, Lord Henley said the available balance showed a substantial increase, but the company had to provide for war risks and for additional war expenses and insurances. The revenue from sale of current so their own consumers and to associated tcompanies in bulk amounted to £532,327, and this had been achieved without any increase in the price of electricity since the war began.

Rushden and District Electric Supply Co., Ltd.—Lord Henley also presided at the annual meeting of this company in the absence of Colonel N. S. Sackville (chairman) when he said that a comparison of the accounts with those of the previous year showed that satisfactory progress had been made. The available balance for the year showed a considerable increase; the revenue from the sale of current was £89,082 compared with £77,685 for 1939, and this had been achieved without any increase in the price of electricity since the beginning of the war.

The Farnham Gas & Electricity Co., reports a balance of revenue of £15,996 on the electricity undertaking and £17,263 from gas. An interim ordinary dividend of £3 1s. 3d. per cent. has been paid and a final dividend at the same rate is recommended.

The Singapore Traction Co. reports a profit for the year to September 30th of £96,236, as compared with £69,252 for 1938-39. The ordinary dividend is maintained at 7½ per cent., and £34,470 is carried forward (against £9,308 brought in).

Ericsson Telephones, Ltd., have declared a final dividend of 12 per cent., with a bonus of 5 per cent., both free of tax, making 22 per cent. free of tax for the year, against 25 per cent. for 1939.

The Rangoon Electric Tramway & Supply Co., Ltd., has declared a final ordinary dividend of 12 annas per share, making one rupee for the past year.

Tilling & British Automobile Traction, Ltd., is paying a final dividend of 3½ per cent., free of tax, making 7 per cent. for 1940 (against 8 per cent.).

New Companies Registered

Automatic Telegraph & Radio Transceiver Co., Ltd.—Private company. Registered February 26th. Nominal capital £100. Objects: To carry on the business of manufacturers of, and dealers in, radio transmitters and receivers, automatic morse transmitters and receivers, and all kinds of wireless telegraphic and telephonic apparatus, equipment and accessories, electricians, etc. Directors: H. Paul-Huhne, "Glenalmond," St. Albans, Herts. (director of British Electric Resistance Co., Ltd.), and F. N. Phipps, C.A., Bank Chambers, 329, High Holborn, W.C.1. Registered office: Bank Chambers, 329, High Holborn, W.C.1.

J. & C. Colbourne & Sons, Ltd.—Private company. Registered March 5th. Capital, £3,000. Objects: To acquire a business carried on by J. and C. Colbourne & Sons at 179A, Dudley Road, Wolverhampton, and Freer Street, Walsall, and to carry on the business of battery service station agents, wireless dealers, electricians, etc. Directors: J. Colbourne, Osborne Villa, Dudley Road, Sedgley, and three others. Registered office: 179A, Dudley Road, Wolverhampton

Ellison (London), Ltd.—Private company. Registered March 11th. Capital £100 Objects: To carry on the business of electrical, wireless, mechanical and general engineers, agents and dealers, etc. Directors: A. W. Ellis, 191, Sheen Lane, East Sheen, S.W.14; and C. J. Comber, 42, St. Matthews Road, S.W.2. Registered office: 1-2, Babmaes Street, Jermyn Street, S.W.

Erg Resistors, Ltd.—Private company. Registered March 6th. Capital £99. Objects: To carry on the business of electrical engineers and contractors, etc. Subscribers: S. Torrance and S. Bagg, both of 4, Broad Street Place, E.C. Secretary: S. Torrance. Solicitors: Sidney Torrance & Co., 4, Broad Street Place, E.C.2.

Exeter Radio & Television Services, Ltd.—Private company. Registered March 1st. Capital £2,000. Objects: To carry on the business of manufacturers of and dealers in wireless and television apparatus and accessories, batteries, electrical equipment, etc. Directors: F. H. E. Amos, chairman and permanent managing director, 51, Larch Road, St. Thomas, Exeter; and two others. Registered office: Midland Bank Chambers, High Street, Exeter.

Mobile Power & Lighting Co., Ltd.—Private company. Registered February 27th. Capital £200. Objects: To carry on the business of manufacturers of and dealers in mobile lighting units, automobiles, vehicles, etc. D. Rowan, Emrow, The Serpentine, Blundellsands, Liverpool, 23, is permanent governing director.

Companies' Returns

Statements of Capital

Edward Dewhurst, Ltd.—Capital £20,000 in £1 shares. Return dated November 1st, 1940. 15,672 shares taken up. £1,502 paid. £14,170 considered as paid. Mortgages and charges: £7,761 7s. 6d.

Hewittic Electric Co., Ltd.—Capital £50,000 in 48,600 ordinary and 1,400 redeemable preference shares of £1 each. Return dated August 14th, 1940 (filed October 22nd, 1940). 40,000 ordinary and 1,300 redeemable preference shares taken up. £40,000 paid on 40,000 ordinary. £1,300 considered as paid on 1,300 redeemable preference. Mortgages and charges: Nil.

Blythe & Marden, Ltd.—Capital £1,000 in 1,000 shares of £1 each. Return dated December 31st, 1939 (filed November 2nd, 1940). 902 shares taken up. £902 paid. Mortgages and charges: Nil.

C. F. Casella & Co., Ltd.—Capital £17,000 in 2,000 preference and 15,000 ordinary shares of £1 each. 2,000 preference and 12,204 ordinary shares taken up. £3,504 paid. £10,700 considered as paid. Mortgages and charges: Nil.

Corporation of Electric Transport, Ltd.—Capital £22,000 in 20,000 preference shares of £1 and 40,000 ordinary shares of 1s. Return dated September 26th, 1940. 39,548 ordinary and 19,548 preference shares taken up. £21,525 8s. paid. Mortgages and charges: Nil.

Grimston Electric Tools, Ltd.—Capital £10,000 in 10,000 ordinary shares of £1 each. Return dated August 29th, 1940. All shares taken up. £7,600 paid, being £1 per share on 6,800 and 5s. per share on 3,200. Mortgages and charges: £5,500.

J. J. Marr & Co., Ltd.—Capital £500 in £1 shares. Return dated September, 1940. All shares taken up. £500 paid. Mortgages and charges: Nil.

W. Mackie & Co., Ltd.—Capital £12,000 in £1 ordinary shares. Return dated October 10th, 1940. 7,500 shares taken up. £3,155 paid, £4,345 considered as paid. Mortgages and charges: Nil.

Eastnor Electric Co., Ltd. — Capital. £10,000 in 10,000 ordinary shares of £1 each. Return dated October 2nd, 1940. All shares taken up. £10,000 paid. Mortgages and charges: Nil.

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STOCKS AND SHARES

TUESDAY EVENING.

THE Government's control of the money market, and the insistence upon 3 per cent. as the maximum rate of interest which will be paid by the Treasury for war borrowing, continue to govern the situation so far as it is concerned with what are called money stocks. Critics are pointing out that it is an anomaly for investment to be asked to put up with 2½ to 3 per cent. interest from the Government at a time when, largely owing to Government demands, the costs of labour and living are rapidly rising. Every company report now being issued bears witness to the pressure of taxation, the most striking example so far being that of the Enfield Cable Works, whose increase of £44,000 in net balance is accompanied by a cut of 3¾ per cent. in the dividend.

Holding-up Reports

The Minister of Information has asked that chairmen and directors of utility companies should postpone publication of accounts, and holding of meetings, until the Government has come to a decision as to how far such information might possibly be of use to the enemy.

The Government's request is assumed to affect companies dealing with electricity supply, gas, water and railways. Most of the electrical concerns and the railway companies have already issued their reports and accounts for 1940, though in a form which implies the likelihood of the companies having been given a quiet hint in advance as to the desirability of acting with restraint in the matter of publishing their statistics. From the purely market point of view, the restriction, which has yet to be formally defined, is not at all likely to affect either the confidence of shareholders in their companies, or the popularity of the shares in electricity supply concerns. One Stock Exchange dealer in the shares ironically remarked that an industry in which reports and detailed accounts are officially prohibited might almost be regarded as a paradise by the shady director!

Stock Exchange markets for industrial shares show comparatively little vitality. No one yet seems to know what are likely to be the implications of the Government plan for the consolidation of industry. Leaders in the commercial world are speaking with caution and reserve at the annual meetings of their various companies. Agreement is general that during the first half of 1940, business in most departments of industry showed profitable briskness, but that in the second six months a decided tendency to fall away became manifest.

Home Railways

The Home Railway companies have held their meetings, and some of the chairmen did not fail to lay about them in good earnest in discussing the criticisms that have been made in Parliament, in the Press, and elsewhere, against the companies.

There has been a little more inquiry for Home Railway prior-charge issues, the prices of which show a tendency to improve, though the junior issues are neglected and the market is dull. London Passenger Transport "C" has gone back to 32—a fall of 2 points—the stock looking expensive by comparison with, for instance, Great Western ordinary. The latter stands at about the same price as Transport "C" and has just received 4 per cent. as against the Transport "C" 3 per cent. dividend in respect of 1940. Southern Railway stocks are easier on balance. The 5 per cent. preference went back to 79 before recovering to 80.

Taxation Toll

The advance estimates quoted here of the manner in which electricity supply dividend declarations for 1940 would be affected by war conditions, are borne out by results now in course of publication. The London companies have reduced their dividends; the Provincial undertakings have maintained previous rates. The latter, too, announce excellent figures for the past year, and shareholders have no reason to feel any qualms about the security of their investments. The changes in prices on the week are of little consequence. London Associated Electrics, at 16s. 3d., are again $\frac{1}{16}$ harder on account of the unexpected dividend, making 4½ per cent. for the year. Associated Electrical Industries did very well in 1940, but taxation took nearly an extra million pounds, and the usual dividend of 10 per cent. is maintained. The British Thomson-Houston Co. made an extra profit of £320,000. After provision for taxation, the 7 per cent. dividend is continued. Associated Electrical Industries holds a controlling interest in the B.T.H. Company.

Price Fluctuations

The recent pressure to buy Cable and Wireless ordinary stock which raised the price eight points in a fortnight, has been succeeded by a little profit-taking, but the price at 60½ is no more than 10s. lower on the week. Oriental Telephones are 3s. 9d. up at 55s., for the reason given here last week. A rise of five points in Mexican Light & Power Electric first mortgage bonds is notable if only for the rarity of any movement occurring in this direction. Reduction of the British Aluminium dividend from 12½ to 10 per cent. led to the price being put down $\frac{1}{16}$ to 39s. 6d. General Electrics are 9d. harder at 79d. 6d. and Murex rose $\frac{1}{16}$ to £4. Telegraph Constructions have recovered the deduction of the dividend and are now 36s. 3d. The company's 77th annual general meeting was held to-day—Tuesday—and the chairman's statement pointed out that all the branches are working to full capacity. This is interesting as showing that the company has fully completed the change-over from its previous work of heavy marine cables to the lighter branches of the industry. J. Lucas ordinary have improved to 56s. 3d. Aron ordinary are harder at 17s. 6d. E. K. Cole at 4s. 6d. are 6d. nearer to their par value of 5s.

Enfield Cable

The Enfield Cable Works provided an unpleasant surprise by announcing a dividend of 6¼ per cent., to make 12½ per cent. for the year, comparing with 16¼ per cent. in the previous period and 25 per cent. for 1938, when the capital was smaller than it is now. What made the disappointment worse, was the fact that the profit for the year just ended, showed an increase of £44,000. The cut of 3¾ per cent. in the dividend left the dealers in the shares completely puzzled, although, of course, it was assumed that taxation would be found responsible for the result. The price of the shares was left nominally unchanged at 50s., at which the return, allowing for inclusion of the dividend, comes to a little over 5 per cent.

British Insulated

As it happened, announcement of the disappointing Enfield Cable dividend was promptly succeeded on the "Trans-Lux" machines in the Stock Exchange by a satisfactory announcement from British Insulated Cables. This company declared the usual 10 per cent. dividend and 5 per cent. bonus, making, with the interim dividend, 20 per cent. for the year. This had been generally expected, though, having regard to the cut in the Enfield Cable distribution, a momentary uneasiness arose lest the British Insulated company should follow suit. The price of British Insulated shares—"Wires" as they are still called in the Stock Exchange market—hardened a shade, to 80s. bid, at which the yield on the money is 5 per cent.

Post-War Prospects

The pressure of taxation is becoming more and more felt as time goes on. With the Budget looming ahead, people are asking whether the limit of the burden has yet been reached. But in this connection, it is borne in mind that investment has to look beyond the present war and endeavour to forecast what is likely to happen at the end of hostilities. The moral is, of course, that while present-day dividend payments may prove, in some cases, less than had been expected, the holder of shares in front-rank companies such as the majority of those engaged in electrical equipment work, need have no qualms in retaining his interest, looking to post-war conditions for his reward.

Harking back to the experience of the 1914-18 war, it may be recalled that the manufacturing and equipment companies did a vast amount of war work and later, under peace conditions, their activities were increased rather than diminished. Profits forged ahead and, so far as can be seen at present, a similar state of affairs is likely to prevail at the end of the present struggle. The cable and equipment companies stand at no great expense in converting their plant to war interests; later on, there will be little fresh expenditure required in re-conversion.

In addition to the business which the companies are now engaged in carrying out for the Government, an enormous amount of private work is also being done at the present time, as one result of enemy action. Fresh installations and new work are constantly in progress; it is not unduly optimistic to look for these conditions to continue long after the war is over.

ELECTRICAL COMPANIES' SHARES

Prices, Dividends and Yields

Company	1940 Highest	1940 Lowest	Dividend Previous	Dividend Last	Middle Price March 17	Rise or Fall	Yield p.c. £ s. d.
Home Electricity Companies							
Bournemouth and Poole ..	63/6	36/6	15	12½	46/3xd. ..		5 8 3
British Power and Light ..	30/-	20/-	7	6	24/6xd. ..		4 18 1
City of London	28/-	20/-	7½	7	20/- ..		7 0 0
Clyde Valley	33/6	24/-	8	8	35/- ..		4 11 5
County of London ..	43/3	21/-	10½	8	30/- ..		5 6 8
Edmundson's:							
7% Pref.	32/-	24/3	7	7	28/3 ..		4 19 1
Ord.	27/6	18/6	9	6	24/6 ..		4 18 0
Elec. Dis. Yorkshire ..	40/3	32/-	9	9	36/3 ..		4 19 4
Elec. Fin. and Securities ..	42/-	34/6	12½	12½	40/- ..		6 5 0
Elec. Supply Corporation ..	48/-	39/-	12	11½	37/- ..		6 4 4
Isle of Thanet	16/-	5/6	4	4	7/- ..		—
Lancs Light and Power ..	33/-	21/6	7½	7½	30/-xd.	+ 1/32	5 0 0
Llanelly Elec.	21/-	17/-	5½	5½	20/-xd.	+ 1/32	5 10 0
Lond. Assoc. Electric ..	21/-	12/6	5½	4½	16/3	+ 1/4	5 10 0
London Electric	35/-	19/-	7	7	22/6 ..		6 4 5
London Power Deb. Red ..	105½	100	5	5	102½xd. ..		4 17 6
Metropolitan	41/6	22/6	10	8	31/3xd.	−9d.	5 2 3
Midland Counties	39/-	23/3	8	8	34/6 ..		4 12 10
Mid. Elec. Power ..	40/-	29/6	9	9	33/9 ..		5 6 8
Newcastle Elec.	29/9	22/6	7	7	25/-xd.	+1/-	5 12 0
North Eastern Elec.:							
Ordinary	31/6	16/6	7	7	27/6	+6d.	5 1 9
7% Pref.	32/6	25/6	7	7	30/- ..		4 13 4
Northampton	44/-	33/-	10	10	40/- ..		5 0 0
Notting Hill 6% Pref. (£10)	10½	9	6	6	8½ ..		—
Northmet Power:							
Ordinary	42/3	22/6	10	7	28/9 ..		4 17 4
6% Pref.	29/-	23/-	6	6	28/6 ..		4 4 3
Richmond Elec.	24/6	18/-	6	6	18/9 ..		6 8 0
Scottish Power	38/-	24/-	8	8	35/- ..		4 11 5
Southern Areas	21/3	12/9	5	5	16/2 ..		6 3 1
South London	33/3	20/-	7	7	20/- ..		7 0 0
West Devon	20/-	17/6	5	5	20/- ..		5 0 0
West Glos.	22/-	15/-	2½	4½	16/3 ..		5 10 10
Yorkshire Elec.	40/-	22/6	8	8	36/3 ..		4 8 5
Overseas Electricity Companies							
Atlas Elec.	4/-	1/3	Nil	Nil	2/- ..		—
Calcutta Elec.	37/-	22/6	10*	8*	35/- ..		4 11 5
Cawnpore Elec.	30/-	24/-	10	10	27/6 ..		7 5 9
East African Power ..	25/6	19/6	7	7	25/- ..		5 12 0
Jerusalem Elec.	24/-	15/-	7	7	21/3 ..		6 11 9
Kalgoorlie (10/-)	12/6	9/6	7½	7½	12/- ..		6 5 0
Madras	26/9	21/6	8*	6*	25/- ..		—
Montreal Power	35½	30	1½	1½	27½	−1	5 9 3
Palestine Elec. "A" ..	25/-	10/-	5*	Nil	18/9 ..		—
Perak Hydro electric ..	20/3	13/-	2½	6	17/6 ..		6 17 2
Shawinigan Power ..	27½	19	85cts.	90cts.	18½ ..		—
Tokyo Elec. 6%	69	30	6	6	38½ ..		15 11 8
Victoria Falls Power ..	75/9	56/6	15	15	75/- ..		4 0 0
Whitehall Investments Pref.	17/9	8/-	7½	7½	12/-	−1/-	12 10 0
Public Boards							
Central Electricity							
1950-70	110½	104	5	5	109 ..		4 11 9
1955-75	112½	106	5	5	111	+1	4 10 0
1951-73	107½	102	4½	4½	107 ..		4 4 0
1963-93	96½	90	3½	3½	97 ..		3 12 2
1974-94	91	79½	3½	3½	90	+1	3 12 3
London Elec. Trans. Ltd.	92	87½	2½	2½	93 ..		2 15 9
London & Home Counties							
1955-75	112½	105	4½	4½	105½ ..		4 5 4
Lond. Passenger Transport:							
A	116	104	4½	4½	111½ ..		4 0 9
B	116	102½	5	5	106 ..		4 14 4
C	65½	25	1½	3	32	−2	9 7 6
West Midland Joint Elec.							
1948-68	106½	103	5	5	105½ ..		4 14 9
Telegraph and Telephone							
Anglo-Am. Tel.:							
Pref.	107	85	6	6	100½ ..		5 19 3
Def.	23⅞	18	1½	1½	23½ ..		6 7 8
Anglo-Portuguese	22/6	10/-	8	8	15/- ..		10 13 4
Cable & Wireless:							
5½% Pref.	99¾	66	4½	5½	97½ ..		5 12 10
Ord.	65	27	4	4	60½	−½	6 12 3
Canadian Marconi $1 ..	6/-	4/-	Nil	4cts.	5/- ..		6 11 2
Globe Tel. & Tel.:							
Ord.	32/6	21/6	7½*	6*	27/6 ..		4 7 3
Pref.	27/9	22/6	6	6	27/6 ..		4 7 3
Great Northern Tel. (£10)	20	11	20	20	12½ ..		—
Inter. Tel. & Tel.	5½	2½	Nil	Nil	3 ..		—
Marconi-Marine	30/-	18/3	10	7½	22/6 ..		6 13 3
Oriental Telephone Ord. ..	2⅞	45/-	12*	11½*	2⅝	+ 1/16	4 3 8
Telephone Props	15/-	11/-	6	6	11/3 ..		10 13 4
Telephone Rentals (5/-) ..	9/6	5/3	10	10	7/3 ..		6 18 0
Traction and Transport							
Anglo. Arg. Trans.:							
First Pref. (£5) ..	4/3	1/-	Nil	Nil	2/- ..		—
4% Inc.	11½	2	Nil	Nil	6½ ..		—
British Electric Traction:							
Def. Ord.	830	100	5	45	800 ..		5 12 6
Pref. Ord.	169	130	8	8	150 ..		5 6 8
Bristol Trams	48/6	32/6	8*	8	35/- ..		4 11 5
Brazil Traction	12½	5½	$1	50c.	7 ..		—
Calcutta Trams	24/-	16/3	8	5½	19/- ..		5 15 8
Cape Elec. Trams	18/6	16/-	5	5	17/- ..		5 17 4
Lancs Transport	35/-	27/6	10	10	35/- ..		5 14 3
Mexican Light:							
1st Bonds	36	25	5	5	40 ..		—
Rio 5% Bonds	95	74	5	5	85 ..		5 17 8
Southern Rly.:							
5% Prefd.	79	35	5	5	44½	−1	11 7 4
5% Pref.	104½	59	5	5	80	−½	6 5 0
T. Tilling	45/9	29/-	10	10	41/3 ..		4 17 0
Tilling & B.A.	47/6	41/9	9*	8*	44/6 ..		—
West Riding	35/-	25/-	10	10	35/- ..		5 14 3
Equipment and Manufacturing							
Aron Electricity Ord. ..	17/6	10/-	15	Nil	17/6	+6d.	—
Assoc. Elec.							
Ord.	43/3	26/6	10	10	40/- ..		5 0 0
Pref.	36/6	32/3	8	8	35/- ..		4 11 5
Automatic Telephone & El.	47/2	32/-	12½	12½	43/9 ..		5 14 1
Babcock & Wilcox ..	50/-	28/6	10	11	40/-	−9d.	5 10 0
British Aluminium Ord. ..	56/-	29/-	12½	10	39/6	− 1/4	5 1 3
British Insulated Ord. ..	92/6	67/-	20	20	80/- ..		5 0 0
British Thermostat (5/-) ..	14/9	6/6	18½	18½	11/3 ..		8 4 6
British Vacuum Cleaner (5/-)	12/-	4/9	40	12½	6/3 ..		10 0 0
Brush Ord.	4/6	1/9	Nil	Nil	4/- ..		—
Callender's	69/-	46/-	15	15	63/9 ..		4 13 9
Chloride Elec. Storage ..	72/6	55/-	15	15	62/6 ..		4 16 0
Consolidated Signal ..	72/6	59/-	17	17	65/- ..		5 4 7
Crabtree (10/-)	24/9	17/6	17½	17½	22/6xd. ..		7 15 7
Crompton Parkinson:							
Ord. (5/-)	20/-	12/-	30	20	18/9 ..		5 6 8
E. K. Cole (5/-) ..	5/-	2/6	10	Nil	4/6	+6d.	—
Elec. & Musical Industries							
(10/-)	10/3	4/3	5	Nil	7/6 ..		—
Electric Construction ..	36/3	27/6	13½	10	27/6 ..		7 5 6
Enfield Cable Ord. ..	56/-	40/6	16¼	12½	50/- ..		5 0 0
Electrical Switchgear (10/-)	22/6	20/-	16	10	20/- ..		5 0 0
English Electric	33/9	16/6	10	10	30/- ..		6 13 4
Ensign Lamps (5/-) ..	15/3	12/6	25	25	15/-xd.	+3d.	8 6 3
Ericsson Tel. (5/-) ..	39/3	23/-	25*	25*	35/- ..		—
Ever Ready (5/-)	28/3	16/6	30	40	25/6	−6d.	7 7 0
Falk Stadelmann	18/3	12/6	6	7	15/9 ..		8 17 10
Ferranti Pref.	25/-	22/-	7	7	25/- ..		5 12 0
G.E.C.:							
Pref.	32/6	26/-	6½	6½	32/6 ..		4 0 0
Ord.	83/3	53/3	20	20	79/6	+9d.	5 0 6
Greenwood & Batley ..	25/6	20/-	15	13	20/- ..		13 0 0
Hall Telephone (10/-) ..	18/6	8/9	15	10	10/- ..		10 0 0
Henley's (5/-)	21/6	12/6	20	20	20/- ..		5 0 0
4½% Pref.	21/2	20/6	4½	4½	21/3 ..		4 4 8
Hopkinsons	46/9	32/6	15	15	38/9 ..		7 14 8
India-Rubber Pref. ..	21/-	19/6	5½	5½	21/3 ..		5 3 6
Intl. Combustion	121/3	70/-	32½	30	90/- ..		6 13 4
J. Lucas	60/6	40/-	15	15	56/3	+ 1/4	5 6 9
Johnson & Phillips ..	50/9	32/6	12½	15	45/- ..		6 13 4
Lancashire Dynamo ..	59/9	47/6	25	20	52/6 ..		7 12 4
Laurence Scott (5/-) ..	11/-	6/-	15	15	9/- ..		8 6 8
London Elec. Wire ..	25/6	20/-	7½	7½	22/- ..		6 13 4
Mather & Platt	46/6	30/-	13½	10	36/3	−9d.	5 11 1
Metropolitan Elec. Cable Pf.	22/-	21/3	5½	5½	21/3 ..		5 3 6
Murex	86/9	52/6	20	20	80/-	+ 1/4	5 0 0
Pye Deferred (5/-)	9/-	6/9	25	25	10/- ..		14 5 8
Revo (10/-)	20/9	11/6	17½	5	20/- ..		2 10 0
Revrolle	60/6	41/-	12½	12½	50/- ..		5 0 0
Siemens Ord.	23/9	15/6	7½	7½	20/- ..		7 10 0
Strand Elec. (5/-)	2/3	9d.	4	2	1/9 ..		5 14 4
S. Smith (1/-)	8/-	3/6	37½	50	6/3 ..		8 0 0
Switchgear & Cowans (5/-)	11/9	5/6	20	10	8/9 ..		5 14 3
Telegraph Condenser (10/-)	8/9	6,3	5	..	7/6 ..		—
Telegraph Construction ..	42/6	29/-	10	10	36/3xd.	+ 1/2	5 10 6
Telephone Mfg. (5/-) ..	9/-	5/-	9	9	7/- ..		6 8 7
Tube Investments	96/9	59/-	23¾	22¾	90/- ..		5 5 9
Vactric (5/-)	3/6	2/-	4	Nil	2/3 ..		—
Vickers (10/-)	22/-	9/6	10	10	14/6	−6d.	6 18 0
Ward & Goldstone (5/-) ..	19/6	12/6	20	20	13/9 ..		7 5 6
Westinghouse Brake ..	46/-	30/6	17½	10	40/- ..		5 0 0
Walsall Conduits (4/-) ..	26/6	17/6	55	55	26/3 ..		8 7 6
West, Allen (5/-)	7/-	3/-	10½	7½	3/9 ..		10 0 0

* Dividends are paid free of Income Tax.

CONTRACT INFORMATION

Tenders Invited and Accepted. Schemes Promising Electrical Work

Contracts Open

Where "Contracts Open" are advertised in our "Official Notices" section the date of the issue is given in parentheses. Further details of items marked with an asterisk can be obtained from the Department of Overseas Trade (Inquiry Room), Millbank, Westminster, London, S.W.1.

Lichfield. — Mid-Staffs. Joint Hospital Board. Installation of electric lighting, heating, wireless, &c., and also laundry machinery at Wissage Hospital. Contractors should send their names to Mr. L. Traw, city engineer, Guildhall.

Maidenhead. — March 31st. Borough Council. Pumping machinery to deal with crude sewage at three automatic electrically operated pumping stations. Particulars and forms of tender from Howard Humphreys & Son, consulting engineers, 7, Eldon Square, Reading, Berks, by March 17th. (Deposit £2 2s.) Tenders to H. E. Davies, Town Clerk, Guildhall.

South Africa.—PRETORIA.—March 26th. City Council. Switchgear, transformers, reactors and auxiliary apparatus. (February 14th.)

April 2nd. City Council. Pipework equipment for the power station. (February 21st.)

April 10th. Union Tender and Supplies Board. Electric cooking apparatus, refrigerator, etc., for the Police Station, Springs. (T.15949/41.)*

CAPE TOWN.—March 31st. Electricity Department. 2,000 fuses. (T.15821/41.)* Ironclad service cut-outs. (T.15820/41.)*

April 15th. 100 AC electricity meters. (T.15985/41.)*

JOHANNESBURG.—April 7th. City Electricity Department. Automatic fire-fighting equipment for switchgear and transformers. (T.15847/41.)*

April 15th. Railways and Harbours Administration. Automobile batteries. (T.15961/41.)*

Southport.—March 25th. Electricity Department. Oil cooled static transformers. (March 14th.)

Stone (Staffs). — March 26th. U.D.C. Supply, laying and jointing e.h.v. and l.v. cables. Specification from electrical engineer, 56, High Street.

Thurles.—April 17th. U.D.C. Four electrically driven centrifugal pumps for sewage scheme. Particulars from Mr. N. O'Dwyer, consulting engineer, 6, Burlington Road, Dublin.

Tipperary.—April 19th. Board of Health and Public Assistance. X-ray equipment for county hospital at Cashel. Mr. E. Beary, secretary, District Hospital, Clonmel.

Orders Placed

Cardiff.—Electricity Committe. Accepted. Cables for twelve months.—Aberdare Cables; Metering equipment (£261).—Metropolitan-Vickers Electrical Co. Ash handling contactor equipment (£853).—Watford Electric & Manufacturing Co. Feed pump repairs (£99).—G. & J. Weir.

Friern Barnet. — General Purposes Committee. Recommended. Installation of bell system at council offices (£96).—W. Wight & Co.

Newcastle - on - Tyne. — CITY COUNCIL. Accepted. Electrical work in connection with the fitting of illuminated direction signs at the Newcastle General Hospital (£98).—Falconar Cross & Co.

Automatic mercury rectifier plant for a substation (£3,995).—Hewittic Electric Co.

Preston.—ELECTRICITY COMMITTEE. Accepted. Electrically operated crane (£5,903).—Babcock & Wilcox.

Rotherham.—Electricity Committee. Accepted. Mercury arc rectifier plant (£575).—G.E.C.

Southend - on - Sea. — Electricity Committee. Accepted. Three electric batteries (£230).—Chloride Electrical Storage Co.

Wakefield.—General Purposes Committee. Accepted. Installation of lift at town hall (£429).—Evan's Lifts.

Contracts in Prospect

Particulars of new works and building schemes for the use of electrical installation contractors and traders. Publication in this section is no guarantee that electrical work is definitely included. Alleged inaccuracies should be reported to the Editors.

Abergavenny.—Housing site, Llanvihangel Crucorney, for R.D.C.; clerk, Council Offices, Monk Street.

Bewdley.—Alterations, George Hotel, Load Street; J. H. Cooper.

Blackpool.—Office, Cocker Street; Leavesley Bros., Ltd.

Bolton. — School shelters (£15,220); borough engineer.

Boston.—Maternity hospital for Holland C.C.; W. M. Smith, County architect, County Hall.

Bradford.—X-ray department, Grassington sanatorium (£1,120); Mr. W. V. Patrick.

Bromsgrove.—Mortuaries, Clant, Alvechurch, Wythall and Stoke Prior, for R.D.C.; surveyor, Council Offices, Birmingham Road.

Cleobury Mortimer.—24 houses for Ludlow R.D.C.; G. W. Graham, surveyor, Rural Council Offices, Ludlow.

Coleshill.—Completion of sewage works extension scheme; Birmingham Tame and Rea District Drainage Board, Colmore Row, Birmingham.

Collyhurst. — Rebuilding Three Tuns, Rochdale Road, for Threlfalls Brewery Co., Ltd., Salford; B. Waterhouse, architect, 134, Deansgate, Manchester.

Colne Valley.—Additions to Town Hall, for U.D.C.; A. Shaw, architect, 59, Knowle Road, Golcar.

Coventry. — Guild House, Sherbourne Street, for T.C.; Constable Hart & Co., Broadway Buildings, Westminster, S.W.1.

Church Hall corner of Church Lane and Kendall End Road; Rev. H. R. Chaffer, The Parsonage, St. Michael's, Cofton.

Darlington.—Welding shed, Barton Street; Riley and Neate, engineers, Haughton Road.

Durham.—Alterations, including new turbine (£5,600), at County Mental Hospital, alterations at Winterton Hospital (£500), additional accommodation at Shire Hall (£900), and infectious diseases cubicles at Bishop Auckland Institution; F. Willey, county architect, 34, Old Elvet.

Rebuilding of premises in Morley Crescent (£870); S. Dodds, R.D.C. surveyor.

Enfield. — Office extensions, Chaseside Eng. Co., Gt. Cambridge Road; H. H. G. Robinson & Son.

Gateshead-on-Tyne.—Extensions, clothing factory, Messrs. Jayes; J. R. Rutherford & Sons, The Minories Joinery Works, Jesmond Newcastle-on-Tyne.

Financial Section (*Continued from page 490*)

Edward Wilcox & Co., Ltd.—Capital, £5,000 in 900 7 per cent. cumulative preference and 4,100 ordinary shares of £1. Return dated July 3rd, 1940 (filed October 12th, 1940). All shares taken up. £4,600 paid on 600 preference and 4,000 ordinary shares. £400 considered as paid on 300 preference and 100 ordinary. Mortgages and charges, £3,888 6s. 8d.

W. E. Chappell, Ltd.—Capital, £1,000 in 1,000 shares of £1 each. Return dated October 31st, 1940. 813 shares taken up. £165 paid. £648 considered as paid. Mortgages and charges, nil.

Increase of Capital

Walsall Electrical Co., Ltd.—The nominal capital has been increased by the addition of £2,000 beyond the registered capital of £4,500. The additional capital is divided into 1,000 ordinary and 1,000 non-redeemable preference shares of £1 each.

Receivers Released

Nefa Co., Ltd.—M. Rubins, of Bristol House, Southampton Row, W.C.1, ceased to act as receiver and manager on February 8, 1941.

McEwan & Co. (Brighton) Ltd.—N. W. Osborne, of 11/12, Finsbury Square, E.C.2, ceased to act as receiver and manager on February 6, 1941.

Douglas Keith, Ltd.—Alfred Laban, of 25/7, Oxford Street, W.1., ceased to act as receiver and manager on January 14th, 1941.

Mortgages and Charges

Erskine Laboratories, Ltd.—Two mortgages on moneys due under contracts, both dated February 18th, 1941, to secure all moneys due or to become due from the company to Westminster Bank, Ltd.

Liquidations

Northleach Electric Supply Co., Ltd.—Meeting, pursuant to section 236 of the Companies' Act on April 15th at Devon House, Northleach, to receive an account of the winding-up by the liquidator, Mr. A. D. Ward.

Napier & Wheeldon, Ltd.—Winding up voluntarily. Liquidators, Mr. S. D. Moore, Victoria Chambers, Bowlalley Lane, Hull, and Mr. A. Wheeldon, 72, The Roundway, Anlaby Park, Hull.

Bankruptcies

E. Prince, now residing at 1, Bellcroft Villas, Allerton Bywater, Yorks, lately carrying on business at 3, Sagar Street, Castleford, as a radio and electrical dealer.—Receiving order made February 28th on debtor's own petition. Public examination April 17th, at the Court House, Wakefield.

H. J. Fowlie, electrical engineer, 40, Queen Street, Maidenhead.—Last day for receiving proofs for dividend March 28th. Trustee, Mr. J. B. Simmons, 8, The Forbury, Reading, Official Receiver.

K. H. Mullinger, electrician, Radio Exchange Stores, King Street, Melksham.—First and final dividend of 7d. in the £ payable March 25th, at 24, Baldwin Street, Bristol.

E. E. Garfield, electrician, 49, Irmond Street, Aston, Birmingham.—First and final dividend of 3d. in the £, payable March 29th, at 37, Temple Street, Birmingham.

Glasgow.—Power house, Yoker; Bull's Metal & Melloid Co., Ltd.

Haslemere.—Development of land, Holdfast Lane; W. J. Green, Electra House.

Hampton.—Hall at factory, Oldfield Road; Gays (Hampton), Ltd.

Hebburn-on-Tyne.—Alterations to workshops for A. Reyrolle & Co., Ltd.; Cackett, Burns Dick and McKellar, architects, 21 Ellison Place, Newcastle-on-Tyne.

Hounslow.—Extensions at Chest Clinic (£575), for Middlesex C.C.; county architect, Middlesex House, 20, Vauxhall Bridge Road, London, S.W.1.

Hull.—Houses, Anlaby; A. I. Windross & Partners, Colonial Chambers, Prince's Dock Side.

Hyde.—Works; Manchester Grit Co., Castle Street, Blackfriars, Manchester.

Works, Waterside Mills; Packing Materials Association, Ltd., Little Green Works, Collyhurst Road, Manchester.

Lanarkshire.—Shelters for County Council (£63,000); County Council architect, Hamilton.

Leeds.—Five community feeding and kitchen centres, for T.C.; W. S. Cameron, city engineer, Civic Hall.

Llandudno.—Conversion into flats, third floor of Montague Burton Building, St. George's Place; Mr. Schaffer.

Mansfield.—Municipal restaurants, Pleasley Hill and Newgate Lane area, for T.C.; W. Thompson, borough surveyor, Carr Bank.

Mottram St. Andrews.—Macclesfield R.D.C. to erect 14 houses; J. H. Walters, architect, 19, Moody Street, Congleton, Ches.

Newbury.—Sewage pumping station (£10,000), for R.D.C.; Clerk's Office, Phœnix House, Bartholomew Street.

Northampton.—Maternity Home, Blagborough Hall, for Northamptonshire Health Committee; G. H. Lewin, County architect, County Hall.

Ormskirk.—Communal feeding and cooking centre in Burscough Street, for U.D.C.; E. J. Wright, surveyor, Council Offices.

Plymouth.—Plant renewal, etc., Prince Rock depot; borough engineer.

Rotherham.—Works extensions; J. Brown & Co., Ltd.; Collieries, Parkgate.

Freezing rooms at Cold Stores, Corporation Street, for T.C.; V. Turner, borough surveyor, Town Hall.

Works extensions; J. J. Habershon, Ltd.

Community feeding and cooking centres at Eastwood and Greasbrough for T.C. (£3,000); V. Turner, borough engineer, Town Hall.

Sheffield.—Sales showrooms on The Moor and Porter Street; Williams, The Trimming House, Ltd., The Moor.

Baptist church, Parson Cross Estate; The Secretary, Yorkshire Association of Baptist Churches.

Manor branch library, Ridgeway Road; city engineer, Town Hall.

South Elmshall.—Church, Moorthorpe (£5,000); Rev. H. Milner, Parish Church.

Stone (Staffs.).—Houses and flats; U.D.C. surveyor, Town Hall.

Stretford.—Offices, Elsinore Road; E. Boydell & Co., Ltd.

Cable store, United Road; W. T. Glover & Co., Ltd.

Sunderland.—Electrical instruction workshop, Sunderland Technical College; O. H. Mark, Education Offices, Tatham Street.

Swinton.—Branch co-operative stores, Station Street; Eccles and District Co-operative Society, Peel Street, Eccles.

Tamworth.—Alterations, Peel School, Lichfield Street, to form community kitchen, for T.C.; borough surveyor, Municipal Offices.

Tottenham.—Works alterations; British Tungsram Radio Works.

Twickenham.—Sunray treatment room, Colne Road; Y. J. Lovell & Son, Ltd.

Warrington.—Works extensions; T. Locker & Sons, Ltd.

Canteen, first-aid post and store at works; The Winwick Tannery, Ltd., Winwick Street.

Works extensions; N. Greening & Sons, Ltd.

Distributing switch house, Howley electricity works; Brew Bros., contractors, Cadishead, near Manchester.

Works additions; Winwick St. Tannery, Ltd.

Warwickshire.—Depots, centres and garages (£30,000); county architect.

Watford.—Maternity home (£6,200); E. and L. Berg, Ltd.

Wexford.—Bungalows (34), Green Street, for T.C.; J. J. Byrne, town clerk, Town Hall.

Winsford.—Structural alterations to the Railway Inn, Railway Street; C. H. Slorah, resident architect, Burtonwood Brewery Co., Ltd., Collins Green, Newton-le-Willows.

Winslow.—Water pumping station, for Bucks Water Board; resident engineer, Crown Buildings, High Street, Aylesbury.

Wolverhampton.—Office extensions, Clarence Street; Wilson Lovatt & Sons, Ltd.

London Transport Board

Report for 1939-40

OWING to an alteration in the accounting period, the latest report of the London Passenger Transport Board covers the eighteen months from July 1st, 1939, to December 31st, 1940. After pointing out that the war has made it impossible to give as full an account of the Board's activities as usual, the report proceeds to explain the financial arrangements made in connection with Government control of railways. The guaranteed net revenue in the case of the Board is equivalent to that earned by the Board for the year ended June 30th, 1939, i.e., about £4,480,000, which is sufficient to cover the interest on the prior charge stocks and to afford about 1½ per cent. on the "C" stock. The Board is entitled to 11 per cent. of any surplus which may be earned. For 1940 the combined net revenues of the railway companies and Board exceeded the guaranteed amount by nearly £3,000,000.

The Board's net revenue for 1940 was £4,811,981; sundry additions raise the figure to £4,853,236. Interest upon the prior charge stocks absorbs £4,080,447, leaving £772,789 for the service of the "C" stock. An interim payment of ¾ per cent. was made in August last and a final payment of 2¼ per cent. is being made; a balance of £1,825 is carried to the stock interest fund.

A total of £4,145,000 has been carried to the renewal reserve (against £2,570,000 in the preceding period). The maintenance reserve has received £100,000, but against this £210,770 has been spent, reducing the balance at the credit of the reserve to £91,999. Authorised commitments at December 31st, 1940, amounted to £148,412.

During the period under review a total capital expenditure of £8,003,012 was incurred; this was allocated as follows: Railways, £4,743,746; buses and coaches, £252,389; trolley-buses, £1,103,592; power supply improvements, £1,357,024; and miscellaneous, £646,759. There was a net credit of £100,498 on the tramways account.

Up to the outbreak of war satisfactory progress was being made with the 1935 programme of extensions and improvements, but it then became necessary to suspend the completion of certain of the works. On the Metropolitan Line the new tube from Baker Street to Finchley Road has been completed and a service of Bakerloo trains to Stanmore commenced in November, 1939. The new escalators at Baker Street, the reconstruction of the Metropolitan ticket hall at the station and the reconstruction of Eastcote station have been completed and the construction of King's Cross station is nearing completion.

All the platforms on the Bakerloo Line have been lengthened and the extension of the Elephant and Castle sidings is approaching completion. On the Central Line the installation of standard tube track and the lengthening of the platforms have been completed and the high-speed lifts at Oxford Circus are almost finished.

The running of Northern Line trains to High Barnet on the L.N.E.R. commenced in April last year. The new station building at East Finchley and the new Highgate station are in service. The electrical equipment of a section of the L.N.E.R. for the operation of Northern Line trains to Mill Hill East is proceeding.

Since June 30th, 1939, 35 route miles of tramway have been converted to trolley-bus operation; altogether 226 route miles have now been converted and 1,611 trolley-buses have been brought into operation. The further conversion of tramways to trolley-bus working has been deferred. Work is proceeding on the re-equipment of Greenwich power station and the sub-stations which it serves. During the period under review 557 new railway cars were put into service.

The report gives particulars of methods adopted to meet the new circumstances created by the war, particularly the black-out, petrol rationing and air-raids. Mention is also made of the great evacuation of mothers and children from London which was carried out without a single mishap; the use of tube stations as shelters; air-raid precautions; war damage; staff reorganisation, etc.